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# DOMINION ENERGY SOUTH CAROLINA MARKET CHARACTERIZATION



## Dominion Energy South Carolina Market Characterization

### Residential Results

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# 1. Executive Summary

This report summarizes the methodologies and key results for the residential market characterization study in support of Dominion Energy South Carolina's (DESC's) Demand Side Management (DSM) Potential Study. The research objectives of this effort were developed in coordination with DESC and were refined based on feedback from Energy Efficiency Advisory Group (EEAG) stakeholders.

## 1.1 Study Objectives

This Market Characterization study objectives included several inputs into DESC's 2022 DSM Potential Study. This market assessment was geared toward providing potential model inputs that are well-grounded in DESC's customer base while also characterizing DESC's entire market in terms of energy efficiency (EE) opportunities and barriers.

The Market Characterization report addresses the following research questions:

- Who has participated in programs to date and who has not? What are the characteristics associated with participants versus non-participants?
- Amongst non-participants to date, what are the size, annual energy usage, segment and geographic characteristics?
- How important is EE in decision-making for customers in light of all other priorities?
  - How important is the utility bill in the customer's hierarchy of basic needs? For residential customers, the utility bill is in relation to income and other basic needs such as shelter and food.
- How much are residential customers willing to pay for DSM or invest in energy efficiency upgrades? What are the competing activities by market segment?
- What is needed to get customers to participate in DSM/EE programs in terms of incentives, marketing, partnering and implementation approaches?
- What does the decision-making power in each market look like? Who owns/pays the bill and has decision-making authority in each segment and sub-segment? (i.e Renters vs Owners)
- What are the opportunities in midstream and upstream design models for residential and non-residential segments respectively in DESC's territory? What incentive offering (midstream or upstream) would most influence the customer decision making process, provide the most education to customers directly?
- What are the opportunities and barriers to managing winter peaking demand-response amongst DESC residential customers?
- How can DESC best address customer energy education needs in DSM/EE programs?

In addition, the Study Team explored the following research questions as part of a deep dive on low income customers:

- What are the unique conditions and needs of these customers?
- What are building/technology characteristics of these customers and how do they differ from other customers?
- What energy upgrades are most needed in the segment?
- What level of energy burden and insecurity do these customers experience?
- What barriers do these customers experience that limit their involvement in current DESC programs? How do these relate to owner/renter status and geography? Culture and language?
- What customer engagement approaches are most appropriate and effective for these customers?

- What sorts of needs, energy-related or non-energy-related, do these customers have that must be addressed before or in tandem with energy efficiency upgrades? Do the current DESC partners offer these services, or would DESC need to seek new partnerships?
- How well aligned are program strategies with the needs of these customers? Given the needs of and barriers facing these customers, are there other strategies or partnerships DESC should consider?
- What other sources of funding for LI could be leveraged by DESC EE programs?

## 1.2 Target Population

This study focused on DESC's electric customer base (electric only or combo customers) and their electric-using equipment in existing buildings including single family, multifamily and mobile/manufactured homes. In addition to electric-using equipment in the homes, the Study Team explored electric vehicle penetration, and winter peaking demand response opportunities among residential customers. The study explored EE opportunities in residential new construction beyond current industry standard practice. In addition, the team explored the opportunities for midstream and upstream program design strategies. While the study included all electric residential customers, it also dove deeper into primary data collection and explored the unique market needs associated with low income customers. Nonresidential customers, including opt-out customers and small business customers, are included in the forthcoming Commercial Report.

## 1.3 Data Collection Methods and Sources

The Study Team used a variety of data sources to complete this study, including primary data collection, secondary data review, and complex modeling. Primary data collection included three data collection activities: (1) a web survey with residential customers (including a telephone survey option), (2) on-site visits where DESC staff collected data in customer homes, and (3) in-depth interviews with community leaders, distributors, builders, and key DESC staff. In addition, the Study Team reviewed secondary data including RECS data, and conducted literature reviews for midstream/upstream, new construction, and winter peak demand programs.

Table 1. Primary data collection summary

Primary Data Collection	Timeline	Completed Interviews
Residential web survey (with inbound telephone option)	December 2021–January 2022	414
Residential on-site visits	December 2021–February 2022	170
In-depth interviews	January 2022–March 2022	40

The residential web survey measured respondents' willingness to adopt energy-efficient technologies and participate in demand response (DR) programs, barriers to participation, energy perceptions, intent, concern, health, comfort, safety, and additional household characteristics. On-site visits measured the penetration, saturation, and equipment characteristics of heating, cooling, water heating, cooking, refrigeration, pools, faucets, electronics, thermostats, building envelope, and laundry equipment. Data gathered through in-depth interviews include community leader perspectives on interventions and support for low income customers, builder feedback on current residential construction standards, best practices, and areas for opportunity, and distributor and manufacturer perspectives on potential midstream and upstream program design.

## 1.4 Key Findings & Opportunities

### 1.4.1 Potential Model Inputs:

#### Penetration, Saturation, and Equipment Characteristics

The Study Team collected residential penetration, saturation, and equipment characteristics by equipment categories and building envelope measures as key inputs to the potential model. This report includes detailed penetration results

and building characteristics by residential segment. Additional details for all penetration, saturation, and equipment characteristics are provided in Appendix A.

The team was able to determine several key home characteristics and equipment types:

- Single family detached homes are the most common home type (65%) followed by an apartment, multifamily, co-op or condominium (17%), mobile/manufactured home (10%), and duplex or townhome (7%).
- About two-thirds of DESC customers own their home (67%) and one-third rent (33%).
- About half of customers rely on air source heat pumps (ASHPs) (48%) for their primary heating source; an additional 21% have forced air furnaces as their primary heating source.
- All customers have at least one form of cooling equipment, however, 90% of customers have central cooling. Of those with central cooling 53% have ASHP, and the remaining 37% have standard central air conditioning (CAC) without heat pumps.
- The most common water heater type is a storage tank (88%), while 12% of customers have a tankless and less than 1% have a heat pump water heater.
- Manual thermostats are the most common thermostat type, installed in over half of homes (67%). The newest thermostat type, smart thermostats, are installed in just 6% of homes.

These baseline results serve as an important input to the 2022 DESC potential study; however, they also identify specific market needs for DESC customers. Most specifically, the penetration of smart thermostats remains low among DESC residential customers. Smart thermostats provide an opportunity for energy savings and better management of heating and cooling load. This technology is a precursor for future demand response direct load control (DLC) programs.

Additionally, fewer than one percent of customers have heat pump water heaters, providing another area of opportunity for market transformation. HPWH technology is now part of DESC's DSM EE program portfolio and measure list; a new measure in the Heating & Cooling and Water Heating (HCWH) program as of PY11. However, participation and the number of contractors installing HPWH has been limited to date. Nevertheless, heat pump water heaters continue to present an opportunity for market transformation.

## Residential Adoption

The Study Team collected residential adoption results for EE retrofit and demand response programs. For residential existing retrofit programs, the Study Team presented willingness to participate scenarios to customers where the amount of the incremental cost covered by the program varied. The incremental cost is the difference in cost between the high efficiency option and the standard efficiency option. For demand response scenarios, the Study Team presented increased annual incentives for a smart thermostat direct load control (DLC) program and varied rate scenarios for a time of day rate program. Overall, the adoption results presented in this report provide a solid foundation for potential model inputs. These adoption estimates are based on customers' willingness to participate and are adjusted based on their stated barriers and overall program awareness. These estimates serve as a starting point for the adoption inputs into DESC's 2022 DSM potential model.

### 1.4.2 Customer Characterization

As of Fall 2021, DESC had approximately 659,000 electric residential customers. This residential customer database was then characterized through multiple complex analyses: (1) analysis of cleaned and annualized consumption to identify high and low users, (2) load disaggregation analysis of DESC's customer base, and (3) program participation analysis to identify participation between PY1 and PY11.

## Residential Usage

The Study Team examined annualized electricity usage among DESC's residential customers and created groups of low, medium, and high users based on their annual KWH. Through this analysis the team determined that low users

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include customers that use between 1,000 and 6,136 KWH per year. These low users are more likely to be customers from low income areas and to live in multifamily homes. High users have annual KWH usage between 21,819 and 37,501 KWH. These users are more likely to be non-low income and live in single family homes.

In addition, the Study Team calculated annualized usage (KWH) per square foot. The square footage data was obtained through tax assessor data. Overall, average annualized usage per square foot was 8.04 KWH/SQFT (full details provided in Section 4.1)

## Load Disaggregation

The load disaggregation analysis constructed individual account-level regression models that separated whole house electric only consumption data and electric/gas combo consumption data into weather-normalized base load, cooling load, and heating load. The Study Team was able to use this analysis to identify customers that would be important to target with future Winter Peak Demand Response interventions. The analysis identified likely household-specific temperature setpoints for heating in the winter. Temperature setpoint is an estimate of the temperature each customer has set for their thermostat to heat or warm their house. Half of residential customers start heating their homes when the temperature dips below 70°F. About 15% of customers have estimated setpoints at or above 74°F.

DESC customers have relatively high heating setpoints creating opportunities to tailor marketing messaging around reducing these setpoints and encouraging behavioral change. DESC customers with higher set points also are key customers to target with future DR interventions.

Through the load disaggregation analysis, the team was able to identify that about half (53%) of DESC customers are weather sensitive. These weather sensitive customers are also likely to have electric heat. Through subsequent steps in the model, the team further identified customers who are likely to have electric heat. Customers who are likely to have electric heat are a prime population for DESC to target to control winter peak demand.

## Program Awareness and Historical Participation

Awareness of DESC energy efficiency programs ranges from 14% to 46%. Program awareness has increased in comparison to awareness from the previous 2016 study. Nonetheless, awareness is always a barrier to program adoption and has been factored into the Study Team's adoption estimates. Looking at residential customer segments, non-low income respondents indicated being aware of specific DESC programs more often than low income customers. However, not surprisingly, there is one exception: the Neighborhood Energy Efficiency Program (NEEP). Program awareness of NEEP was higher among low income respondents (19%) than non-low income respondents (12%).

Eighteen percent of DESC's current residential customers participating in a past program. This total does not include the seven million bulbs that customers purchased when DESC had a retail store program as those bulbs cannot be tracked to customer account numbers. Program participation and awareness are inextricably linked to the success of DSM programs. Overall, the Heating and Cooling – HVAC program and the HER program had the highest levels of participation across all DESC customers (5.13% for both). The Neighborhood Energy Efficiency Program had the largest share of participation for the low income and multifamily segments (6.73% and 3.04%, respectively). The Heating and Cooling – HVAC program the highest levels of participation for non-low income and single family customers (6.04% and 6.43%).

There are a wide range of current DESC residential customers that have not yet participated in DSM program offerings. While non-participants live more often in multifamily homes than participants. There is still a large group of current single family residential accounts (433,000 or 82%) who have not participated in residential programs. In addition, non-participants come from both low income and non-low income areas equally.

## Decision-Making

Overall, 67% of web survey respondents were owners and 33% were renters. Non-low income and single family respondents were significantly more likely than their counterparts to indicate they owned their home, while low income and multifamily respondents were more likely to be renters. As expected, owners were more likely than renters to

indicate they had decision-making authority for energy efficiency upgrades. Not all DESC customers have decision-making capacity around energy efficiency upgrades making this a barrier to participating in energy efficiency upgrades. To target multifamily customers with low levels of decision-making power, tailored outreach to landlords who own properties within DESC's service territory will help reach this target.

### Energy Efficiency Intent and Concern

Although there is still a portion of customers who have little to no concern in saving energy, the majority of residential customers are concerned with making an effort to reduce their electricity usage, especially customers in low income and multifamily households. When asked, low income respondents were significantly more concerned about affording their household's energy costs than non-low income respondents. These low income customers are likely prioritizing basic needs, such as housing and food. After their most basic needs are met, they struggle to pay for their energy costs. In fact, significantly more low income customers had forgone basic necessities to pay energy bills than non-low income customers in the last year (47% vs. 14%, respectively).

If customers were to come into additional funds such as a future stimulus check, non-low income customers would consider spending it on home and equipment upgrades. Whereas, low income customers would be more likely to spend it on essentials and transportation. When asked where customers would most likely go to seek assistance if they were unable to pay their energy bill 31% of customers would currently seek assistance from DESC customer service.

Average annual DESC electricity costs are similar among low income and non-low income customers, which exacerbates the disparity in energy burden and economic hardship between these two groups. Low income customers have significantly high energy burden and economic hardship.

#### 1.4.3 Midstream and Upstream Programs

Midstream programs, targeting distributors instead of customers or contractors, may have the potential to achieve greater savings than traditional downstream programs because they intervene higher up in the supply chain, which generally enables these programs to reach a larger share of the market than traditional programs. Based on a literature review and interviews with distributors and contractors in DESC service territory, DESC may have an opportunity to capture heating and cooling energy savings through a midstream program design serving both retrofit and new construction. Based on the literature review, lighting, retail products, and HVAC equipment have been the primary residential categories for midstream products. Lighting has already seen a market transformation, especially with newly constructed homes, but lighting controls pose an area of opportunity. Residential HVAC and water heating measures with the most promise for residential midstream models are heat pumps (heat pump water heaters and other heat pump-related technologies) and advanced thermostats. Heat pumps show strong market potential across the US and has proven to be a good fit for the residential midstream program model in some other jurisdictions (Merson et al., 2018) such as California (Guidehouse, 2021). It is vital to be cognizant of the market shifts in response to Covid-19 and current supply chain issues when analyzing historic midstream initiatives to guide future potential programs.

In the DESC service territory, the penetration of air source heat pumps as compared to other services territories is notably higher so it should be noted the potential for such a offering could be less than other jurisdictions reviewed in this study. However, the penetration of heat pump water heaters is less than 1% and may provide opportunity for heat pump technologies in the DESC service territory. The team interviewed nine distributors looking to understand awareness of midstream programs, involvement in this type of program delivery model, and receptivity to participating in a DESC-sponsored midstream program. Interviewees included both lighting and HVAC equipment distributors serving a combination of residential and non-residential buildings. A key takeaway from these interviews is that HVAC distributors were aware of midstream programs and thought favorably of them in general. While HVAC distributors did identify a number of important considerations for a program, they responded positively to the possibility of midstream program design. The Study Team also interviewed HVAC contractors. These contractors expressed concern with the significant incremental cost between standard and high efficiency HVAC unit and did not trust that equipment distributors would pass along midstream incentives to the end-use customer. Additional details are included in Section 11.

### 1.4.4 New Construction

This study did not serve to complete a full review of the new construction practices in the DESC service territory as the focus was primarily on existing housing stock. DESC attempted a new construction program in the initial roll-out of the DSM portfolio over 10 years ago. That program was designed to align with the national ENERGY STAR® New Homes Program. The program was sunsetted within its first three years due to overwhelmingly high levels of free-ridership amongst the State's most active builders who claimed, following evaluation surveys, they were already building to these standards regardless of the program support. Based on the limited research conducted for this study, inconclusive results suggest that there is more research or analysis that could be done to fully explore the opportunities DESC has for implementing effective energy efficiency programs in the area of new construction. Our limited research indicates that there is ample residential new construction happening in South Carolina and that it is projected to increase in the near-term. Concurrently, outdated codes are not requiring highly efficient installation practices of the heating and cooling equipment for residential new construction. Builders instead are claiming that they already build above/greener than code to stay competitive in the marketplace. Although this has not been verified in the field energy efficiency is becoming important enough to home buyers that home builders in the state are using efficiency claims as marketing tactics. However, based on our review of builders marketing and website content as well as our mystery shopper calls, builders are doing so largely without updated tools to measure or provide a coherent definition to what constitutes a "green" or "efficient" home. Builders claim that they are building to more efficient standards than existing building code and using energy efficiency as a marketing point in South Carolina. Information from these marketing materials indicates that more energy efficiency is possible even though current practices may produce a high enough HERS rating to qualify as ENERGY STAR®. For example, one builder is putting in 14 SEER HVAC systems and those could be more efficient at higher SEER levels but still pass the HERS threshold for ENERGY STAR®, one builder claims to install EE air conditioning units but does not specify the level of efficiency, and it's possible that more electric savings could be garnered by incenting the installation of electric heat pump technology for space and water heating instead of gas fueled models. Additional details are included in Section 12.

### 1.4.5 Winter Peak Demand Response

The Study Team identified three types of demand response (DR) interventions that can be leveraged to manage winter peak demand as a part of the literature review. These three DR programs include: (1) Direct Load Control (DLC) heating programs, which require a smart thermostat; (2) weatherization strategies to improve the building envelope and bolster savings; and (3) Time-of-Use (TOU) or Critical Peak Pricing (CPP) rate programs that encourage customers to use energy-consuming appliances like laundry equipment on off-peak hours.

The Study Team gathered information from residential customers on their awareness of DR program designs and interest in DLC programs and TOU programs. Customers had low awareness of DLC programs (20%). Barriers to DLC and TOU participation included a lack of information about the program participation process and concern about sacrificing comfort.

### 1.4.6 Low Income Deep Dive

Low income households have higher energy burden, economic hardship and health hardship scores than non-low income customers on average. Despite a high average energy burden score, results suggest that energy costs were only a mid-tier priority for low income households. About half of households indicated they were highly concerned about energy costs and even sacrificed other essential needs to cover energy bills. However, self-reported 2020 stimulus spending suggests that low income respondents are typically unable to proactively invest money into energy upgrades amidst other expenses.

Low income households are more likely than their non-low income counterparts to have certain types of energy using equipment. For example, low income households were more likely than non-low income households to have gas heating or portable heating as their primary source of heat. Additionally, low income households were less likely than non-low income households to have central cooling and more likely to have a manual thermostat. Low income households are more likely than non-low income households to have a storage (tank) water heater and insulation in

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their crawlspaces and attics. Equipment wise, low income households are more likely than non-low income households to be using non-energy efficient (incandescent) lighting and not have any faucet aerators or low flow showerheads.

The Study Team identified a variety of different types of low-income programs and determined that the most inclusive program design is a portfolio that integrates a combination of program offerings. The team also identified best practices for increasing low income program participation, including aligning eligibility criteria with other income-qualified programs (e.g., WAP and the Low Income Home Energy Assistance Program (LIHEAP)), and making program participation as easy as possible for the customer from start to finish. Additionally, DESC could establish partnerships with local governments, CAPS, and other community-based organizations to better allocate funding, develop marketing materials, and monitor administrative costs.

The community leader interviews revealed that although there is a number of best practices for outreach, community engagement strategies need to be tailored to specific communities. Overall, the community leaders highlighted the need to establish a presence in targeted communities to build a sense of trust with the low income population. They identified that a good way to build trust was with face-to-face interaction and personalized communication. In particular, they highlight customer testimonials of program benefits as a good way to reach low income households with DESC's offerings.

## 2. Study Overview

This Market Characterization study objectives included several inputs into DESC's 2022 DSM Potential Study. This market assessment was geared toward providing potential model inputs that are well-grounded in DESC's customer base while also characterizing DESC's entire market in terms of energy efficiency (EE) opportunities and barriers.

The Market Characterization report addresses the following research questions:

- Who has participated in programs to date and who has not? What are the characteristics associated with participants versus non-participants?
- Amongst non-participants to date, what are the size, annual energy usage, segment and geographic characteristics?
- How important is EE in decision-making for customers in light of all other priorities?
  - How important is the utility bill in the customer's hierarchy of basic needs? For residential customers, the utility bill is in relation to income and other basic needs such as shelter and food.
- How much are residential customers willing to pay for DSM or invest in energy efficiency upgrades? What are the competing activities by market segment?
- What is needed to get customers to participate in DSM/EE programs in terms of incentives, marketing, partnering and implementation approaches?
- What does the decision-making power in each market look like? Who owns/pays the bill and has decision-making authority in each segment and sub-segment? (i.e Renters vs Owners)
- What are the opportunities in midstream and upstream design models for residential and non-residential segments respectively in DESC's territory? What incentive offering (midstream or upstream) would most influence the customer decision making process, provide the most education to customers directly?
- What are the opportunities and barriers to managing winter peaking demand-response amongst DESC residential customers?
- How can DESC best address customer energy education needs in DSM/EE programs?

In addition, the Study Team explored the following research questions as part of a deep dive on low income customers:

- What are the unique conditions and needs of these customers?
- What are building/technology characteristics of these customers and how do they differ from other customers?
- What energy upgrades are most needed in the segment?
- What level of energy burden and insecurity do these customers experience?
- What barriers do these customers experience that limit their involvement in current DESC programs? How do these relate to owner/renter status and geography? Culture and language?
- What customer engagement approaches are most appropriate and effective for these customers?

*Study Overview*

- What sorts of needs, energy-related or non-energy-related, do these customers have that must be addressed before or in tandem with energy efficiency upgrades? Do the current DESC partners offer these services, or would DESC need to seek new partnerships?
- How well aligned are program strategies with the needs of these customers? Given the needs of and barriers facing these customers, are there other strategies or partnerships DESC should consider?
- What other sources of funding for LI could be leveraged by DESC EE programs?

### 3. Methodology

The residential customer research targeted homeowners and tenants in these three key segments: low income, single family, and multifamily residential customers. For purposes of this study, low income customers are those living at or below 200% of the Federal Poverty Level (FPL) for their self-reported household size and income. For sampling purposes, the Study Team matched customer data to their respective census-block groups to flag participants who were likely to live in low income areas. If the customer lived in a block-group where 50% or more of the households lived at or below 200% of the FPL, they were flagged as living in a low income likely area. Multifamily homes include any housing type with two or more units. The team used Dominion Energy parameters of a single household unit to define single family homes. The Study Team identified customers likely to live in multifamily households by identifying duplicate addresses and addresses with a unit or apartment number. All other customers were flagged as single family.

The residential baseline data was collected through a residential customer web survey and residential customer on-site visits. DESC program staff assisted the team with the on-site data collection. In total, the team completed 414 online surveys and 171 on-site visits.

Community specific information for the low income focus of this report was collected through in-depth interviews with community leaders in Aiken, Charleston, and Saluda, as well as DESC program staff working in those communities. Low income program specific data was collected through a literature review. In total, the team conducted 14 interviews with 26 community leaders and reviewed 21 sources.

## 3.1 Primary Data Collection

### 3.1.1 Target population

This study focused on DESC's electric customer base (electric only or combo customers) and their electricity-using equipment. The target population for the residential primary data collection was residential households, including single family, multifamily, and low income homes located in DESC territory. Table 2 describes the estimated population distribution of residential customers across segments. The single family and multifamily categories are not mutually exclusive with the low income category.

The Study Team used the service address, including unit number if applicable, to determine if each residence was single family or multifamily and then flagged it as such. The team flagged a residence as low income if they resided in a census block group where over 50% of the residents were 200% below the poverty line. This approach was necessary because DESC's customer billing data does not contain comprehensive information on low income status and type of home.

Table 2. DESC residential customers by segment

	n	%
Overall	658,999	100%
<b>Income status</b>		
Non-low income	527,774	80%
Low income <sup>a</sup>	131,225	20%
<b>Housing Type</b>		
Single family	504,878	77%
Multifamily	154,121	23%

<sup>a</sup> Customers were flagged as low income likely if they resided in a census block group where over 50% of the residence were 200% below the poverty line.

The next sections give a brief overview of the data collection instruments, the sample design, and methodology of on-site visits and the web survey.

### 3.1.2 Web Survey

The web survey targeted low income, non-low income, single family, and multifamily residential segments. Customers were invited to participate in the survey through a mailed letter invitation and were offered two options for survey mode: web survey or an inbound telephone option to take the survey with a live interviewer. This type of survey with a mailed invitation encourages customers to participate online with a unique survey access code or to call the telephone interviewing center.

The residential web customer survey collected the following information:

- Awareness of EE and demand response programs, EE technologies, and DESC's current energy efficiency programs

- Willingness to adopt EE retrofit technologies and participate in DR programs, as well as barriers to participation
- Energy perceptions, intent, and concerns
- Health, comfort, and safety concerns
- Energy costs and economic hardship
- Electric vehicle penetration, charging capabilities, and interest in EVs
- Demographic information and additional household characteristics

DESC's customer data does not contain information that would allow us to segment the population into the study segments. Therefore, the Study Team developed flags to identify likely low income, single family, and multifamily customers to aid in recruitment, as follows:

- **Low income:** In order to target low income households living at or below 200% of the Federal Poverty Level (FPL), the Study Team matched customer premise data to their respective census-block groups. If the customer lived in a block-group where 50% or more of the households lived at or below 200% of the FPL, they were flagged as living in a low income likely area. Since the online survey collected information on income and household size, the survey results report out on self-reported income status instead of using the low income flag, which is different from the on-site results.
- **Multifamily:** The Study Team flagged multifamily customers, defined as any housing type with two or more units by identifying addresses with unit or apartment numbers and duplicates, which both suggest there may be multiple units within a building. Since the online survey collected information on housing type, the survey results report out on self-reported housing type instead of using the multifamily flag, which is similar to the on-site results.
- **Single family:** The Study Team flagged single family customers, defined as a housing type with only one unit if they did not meet the multifamily flagging criteria. Since the online survey collected information on housing type, the survey results report out on self-reported housing type instead of using the single family flag, which is similar to the on-site results.

The Study Team drew a stratified random sample to complete 400 residential web surveys. Assuming a response rate of 10%–15%, the team used a sample frame of 4,000 residential customers to accommodate a sample size of 400. This sampling strategy aimed to yield statistically valid data for three key segments (low income, single family, and multi-family) with at least 100 completes in the first two segments and 300 in the last segment. As noted in the previous section, not all segments are mutually exclusive, some customers may fall into more than one category such as low income and multifamily.

The Study Team invited customers to participate in the online survey through an invitation mailed to their homes across two waves. The team also provided an option to complete the survey by telephone and followed up with a reminder postcard for each wave for those customers who did not respond to the survey. The Study Team offered residential customers a \$15 e-gift card for their participation in the online survey. Participants who did not have an email address received a physical gift card mailed to their home.

Overall, 414 residential customers completed the survey, with a response rate of 12.3%. The team exceeded the survey target for both housing type segments and for the low income segment. Table 3 summarizes survey targets and survey completes, by segment. Of the 414 completes, 372 respondents completed the survey online and 42 completed the survey over the phone.

Soft quota groups were set up and monitored throughout the data collection process to ensure data collected closely follows the characteristics of DESC's customer base. Data weighting was used in analysis, where needed, to ensure that segments would not be over-represented in results.

Table 3. Online sampling strategy and completes

	Sample Frame	Web Survey Targets	Web Survey Completes
Overall	4,000	400	414
<b>Income status</b>			
Non-low income	2,550	300	275
Low income	1,450	100	139
<b>Housing type</b>			
Multifamily	1,000	100	103
Single family	3,000	300	311

### 3.1.3 On-Site Visits

The residential on-site visits collected the following information:

- Detailed information on building characteristics
- Penetration, saturation, and characteristics of key energy-using equipment
- Heating, cooling, and water heating equipment
- Insulation
- Laundry
- Advanced power strips
- Water-related equipment
- Pool pumps

The target number of completed on-site visits was 300. The Study Team drew a stratified random sample of 5,000 customers across the three key segments (low income, multifamily and single family), aiming for at least 100 completes in the low income and multifamily sub segment, and 200 completes in the single family sub segment, with a goal of 300 total site visits (Table 4). Not all segments were mutually exclusive, as some customers may fall into more than one category such as low income and multifamily. The team recruited participants by phone and provided DESC program staff with the contact information of the recruits, in an ongoing fashion, so that DESC staff could schedule the on-site visit. The Study Team anticipated a 10% attrition rate from on-site recruitment to on-site completes. Once DESC scheduled the on-site visit, DESC program staff would go to the residence and conduct the visit. To encourage participation, the team offered customers a \$50 gift card for their participation in the study.

The team set up and monitored soft quota groups throughout the data collection process to ensure the data collected closely followed the characteristics of DESC's customer base. A few weeks after data collection

began, DESC program staff shared information about their difficulties conducting on-site visits with the team. In response, the Study Team employed a flexible new recruitment strategy where the goal for total number of on-site visits conducted decreased to 150 and more low income customers were recruited to maintain adequate sampling. Data weighting was used in the analyses, where needed, to ensure that segments would not be over-represented in results. Overall, 589 residential customers were recruited to complete an on-site visit and 170 residential customers completed the survey. The on-site recruiter had a response rate of 3.8%. Recruitment exceeded the target for both housing type segments and the low income segment. Due to difficulties with on-site data collection; however, the team did not reach the original on-site completion targets. Table 4 summarizes survey targets and survey completes, by segment.

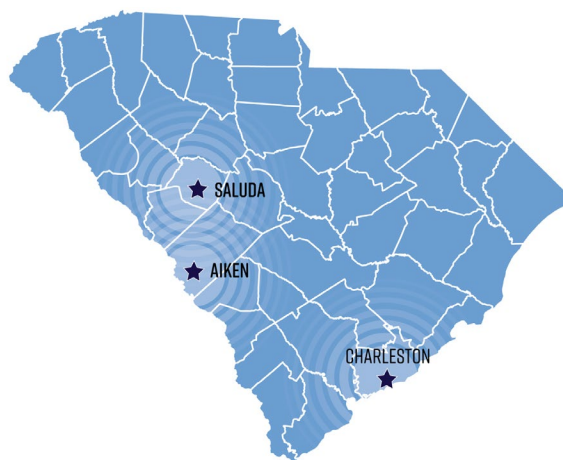
Table 4. On-site sampling strategy and completes

	Sample frame	On-site targets	On-site recruits	On-site completes
Overall	18,289	300	589	170
<b>Income status</b>				
Non-low income	12,970	200	302	81
Low income	5,319	100	287	89
<b>Housing category</b>				
Single family	13,144	200	343	110
Multifamily	5,145	100	246	60

### 3.1.4 Community Leader Interviews

The Study Team conducted in-depth interviews with leaders in three communities: Charleston, Aiken, and Saluda (see Figure 1). We selected these three communities to represent one large, one medium, and one small community. Charleston was selected for the “large” community because it has historically received less research focus than Columbia (i.e., DESC has a strong understanding of Columbia and tests most new program offerings there first); and Charleston achieves relatively less program participation. Aiken, the “medium-sized” community, is comprised of widespread hamlets, villages, and unincorporated areas, which creates unique outreach challenges (e.g., it is more costly and time-consuming to reach Aiken households and businesses, compared to more densely populated cities or more cohesive small towns). NEEP staff have also had challenges finding interested community partners in Aiken. We chose Saluda as the “small” community target because of its rural location and high proportion of Spanish-speaking residents: a demographic that DESC programs have historically had challenges reaching.

Figure 1. Map of Community Leader Interviews



The team spoke with leaders knowledgeable about and/or providers of public or not-for-profit services within the selected communities. The Study Team began the interviews by discussing the communities overall, such as what makes the community unique; key socioeconomic challenges; demographics; and the availability of community-serving institutions (CSIs) (e.g., medical, educational, and social services) in the community. The

Study Team then discussed energy-related topics, which included how low income residents in the communities think about energy savings; the main barriers they face with improving energy management and making energy efficiency upgrades; and opportunities for DESC to reach and support low income residents through their energy efficiency programs. The in-depth interview guide is provided in Appendix F.

The Study Team identified and recruited community leaders through a “snowball” sampling approach, where the team asked interviewees to suggest additional leaders within these communities for the research team to contact. The Study Team ultimately conducted 14 interviews with 26 community leaders (occasionally, there were multiple interviewees present at a single interview) from February through March 2022. The leaders interviewed represented a wide variety of organizations, roles, and services in the communities. The team began with group interviews with DESC staff in the Customer Assistance and Economic Development and Local Government departments who operate within the target communities. The Study Team then leveraged their network of contacts to reach non-DESC-affiliated community leaders, such as chambers of commerce, municipal leaders, state representatives, and local non-profit organizations.

Table 5 provides a detailed list of organizations and the number of leaders the team interviewed in each community.

**Table 5. Community Leader Interview Participation**

Interviewee organization by community	Interviewee count
<b>Aiken</b>	<b>7</b>
Dominion Energy	2
City of Aiken/Clyburn Medical Center	1
Salvation Army	1
Second Baptist Church, SBC Community Development Corporation	1
<b>Charleston</b>	<b>14</b>
Dominion Energy	3
Palmetto Community Action Partnership	5
East Cooper Community Outreach	4
Charleston Promise Neighborhood	1
<b>Saluda</b>	<b>5</b>
Dominion Energy	2
GLEAMNS Human Resources Commission, Inc <sup>a</sup>	1
Potter's House	1

<sup>a</sup> GLEAMNS is an initialism of the counties the agency serves: Greenwood, Laurens, Edgefield, Abbeville, McCormick, Newberry, and Saluda.

In addition, the team also conducted an exploratory interview with the South Carolina Association of Community Action Partnerships (SCACAP) to get a statewide perspective on the roles and services of community action partnerships (CAPs) in communities, as well as how CAP agencies leverage funding for other utilities’ low income programs.

### 3.1.5 Market Actor Interviews

#### Residential New Construction

The Study Team conducted interviews with two prominent builders and a representative from the South Carolina Home Builder's Association in the market to determine if DESC could design a program with the potential to generate savings beyond code or industry standard practice. The Study Team gathered information on what current industry standard practices for residential new construction home building in South Carolina are and what opportunities there may be for DSM. Interview topics included the homes built and planned in DESC's territory, standard practices, EE or "green" practices and building measures, barriers and opportunities for EE in residential construction. The Study Team had difficulty reaching home builders that were interested in participating in an interview; however, the team also reviewed builders websites and reviewed building practices as mystery shoppers looking to build a home.

#### Midstream/Upstream Interviews

The Study Team conducted interviews with distributors in DESC service territory, looking to understand awareness of midstream programs, involvement in this type of program delivery model, and receptivity to participating in a DESC-sponsored midstream program. Interviewees included both lighting and HVAC equipment distributors serving a combination of residential and non-residential buildings. The team completed nine interviews representing eight distributors. The team also facilitated two market actor workshops in March of 2019 at Dominion's offices in Cayce and Charleston, respectively. The first workshop was held with residential contractors and the second workshop was held with residential and commercial equipment distributors. All attendees of the residential contractor workshop service the Columbia area, some service Aiken, and one services Charleston. The discussion topics covered by the residential contractor workshop include: Water Heating, HVAC Equipment, Duct Repair & Replacement, Tune-Ups, Midstream Delivery Channel Program Concept, and Miscellaneous Items.

Five of the eight recruited equipment distributors attended the second workshop. All attendees are lighting suppliers, one distributes commercial food service equipment, and two also supply HVAC and water heating equipment. The HVAC distributors partner with set manufacturers and have agreements with those specific brands. Most of the lighting distributors can essentially sell any type of lighting that a customer requests, but one is an exclusive distributor for one specific brand. The discussion topics covered by the equipment distributor workshop include: Awareness of Current Downstream Model and Offered Measures, and Midstream Delivery Channel Program Concept as it relates to Residential HVAC.

## 3.2 Secondary Data Collection

### 3.2.1 Literature Review

The Study Team conducted a literature review of secondary research papers and EM&V reports to identify best practices in the industry and popular trends among other utilities, targeting many in the southeast region near DESC territory. Through our review, the team closely examined low income programs for approximately 15 utilities across 15 states (see Appendix E for a full list of sources reviewed), marketing, education, and outreach best practices, funding sources, and successful approaches to community partnerships. In addition, the team examined midstream and upstream residential programs, winter-peak demand response and residential new construction.

### 3.2.2 RECS Data

The Study Team reviewed the most recent U.S. Energy Information Administration's Residential Energy Consumption Survey (RECS) for 2020 where available.<sup>1</sup> 2020 RECS data is currently available for lighting and appliances. For equipment categories where 2020 RECS data is not yet available, the team reviewed the most recent 2015 data for the South Atlantic region.<sup>2</sup> These categories include space heating, central cooling and water heating equipment categories.

### 3.2.3 Tax Assessor Data

The team obtained square footage data for all of the counties within DESC territory from CRS Data. CRS Data acquires county level tax assessor data and aggregates this data. The data received had multiple data quality issues that limited the calculation of annualized usage per square foot for residential customers; this is discussed further in the customer characterization section (Section 4.1). The square footage dataset is included as part of this deliverable for DESC as a part of the customer database.

## 3.3 Data Cleaning

### 3.3.1 Quantitative Online Survey

The Study Team identified survey respondents as those who completed the survey or at least the completed up through the demographics section. Other partial completes were excluded from analysis. This resulted in a final survey sample size of 414. Additionally, the team identified nonsensical, unclear, or contradicting answers for a given respondent and recoded these data points to "unknown."

### 3.3.2 On-Site Visit

The Study Team extensively reviewed the on-site data to ensure its accuracy for all 170 audited households. The team held an online training session for all DESC auditors prior to the survey entering the field, which included tablet training and an overview of the survey with an engineering representative from the team. In the instances of unclear, contradicting, or missing information, the Study Team worked with DESC to remedy these items. The team also worked with DESC to ensure consistency during data entry to avoid misinterpretation of the data.

## 3.4 Weighting

The Study Team calculated analysis weights for both survey and on-site data to correct for over- and under-samples related to income status and housing type. The Study Team used two different methodologies for determining the DESC population estimates for the online survey sample and on-site sample.

- **Online survey weights.** The Study Team developed survey weights based on the proportion of survey respondents in each stratum relative to the distribution of DESC's customer population across the same dimensions. The team developed an estimate of DESC population distribution over the study strata by leveraging the US Census Bureau's Public Use Microdata (PUM) datasets, which provide anonymized respondent-level data by Census tract. The team developed counts by stratum for each census tract DESC serves and prorated each by the proportion of the census tract within DESC's

<sup>1</sup> U.S. Energy Information Administration, Office of Energy Demand and Integrated Statistics, Form EIA-457A of the 2020 Residential Energy Consumption Survey, Preliminary data release date: March 2022

<sup>2</sup> U.S. Energy Information Administration, Office of Energy Demand and Integrated Statistics, Form EIA-457A of the 2015 Residential Energy Consumption Survey, Final release date: May 2018

service territory to estimate the total population by stratum. (Table 6) This approach was necessary because the customer billing data provided did not contain comprehensive information on low income status or type of home.

- **On-site visit weights.** The Study Team developed survey weights based on the proportion of survey respondents in each stratum relative to the distribution of DESC's customer population across the same dimensions. The Study Team developed an estimate of DESC population distribution over the study strata by leveraging DESC service address data. The Study Team used the service address, including unit number if applicable, to determine if each residence was single family or multifamily. The Study Team flagged a residence as low income if they resided in a census block group where over 50% of the residence were 200% below the poverty line. This approach was necessary because the customer billing data provided does not contain comprehensive information on low income status or type of home and the on-site instrument did not collect income or housing type data.

As seen in Table 6, the achieved survey sample was similar to the associated population estimate; however, the on-site sample deviated considerably from its associated population estimates.

Table 6. DESC population and unweighted sample proportions (household level)

Stratification grouping	DESC population estimate: online survey	Online survey sample (n=414)	DESC population estimate: on-site visit	On-site sample (n=170)
<b>Income status</b>				
Non-low income	66%	69%	80%	48%
Low income	34%	31%	20%	52%
<b>Housing type</b>				
Single family	75%	75%	77%	65%
Multifamily	25%	25%	23%	35%

To ensure results were representative of the target population (as opposed to being solely indicative of the skewed sample), the team calculated and applied statistical weights. Specifically, the Study Team used the population estimates in Table 6 to calculate calibrated weights using an iterative raking algorithm for the survey and on-site data, respectively. The weighted samples mirror the population proportions found in Table 6. All analyses are weighted. Thus, overall estimates can be interpreted as generalizable to the overall DESC target population. Final weights are presented in Table 7.

Table 7. Weighting values

	Weight
<b>Web survey</b>	
Non-low income single family	0.88767366
Non-low income multifamily	1.26365886
Low income single family	1.33933259
Low income multifamily	0.70339829
<b>On-site visit</b>	
Non-low income single family	2.21961198
Non-low income multifamily	0.93607401
Low income single family	0.41172094
Low income multifamily	0.30435774

### 3.5 Penetration and Saturation Methodology

Penetration and saturation results presented in Section 8 are based on the data collected in the on-site visit primary data collection efforts described above. Penetration and saturation concepts are defined as follows:

- **Penetration:** A percentage representing the proportion of customers with one or more unit of a particular piece of equipment. Penetration is calculated by dividing the number of customers with one or more units of a piece of equipment by the total number of customers responding to that question. For example, the air source heat pump (ASHP) penetration rate for non-low income residential customers is 54%, meaning that 54 out of every 100 non-low income households have an ASHP.
- **Saturation:** A number representing how many units of a particular piece of equipment are present, on average, among all customers. Saturation is calculated by dividing the total number of units of a particular piece of equipment by the total number of customers (including those who do not have the equipment). For example, the saturation rate of LEDs in non-low income customer homes is 30.2, meaning that the average number of LEDS in non-low income homes is 30.2.

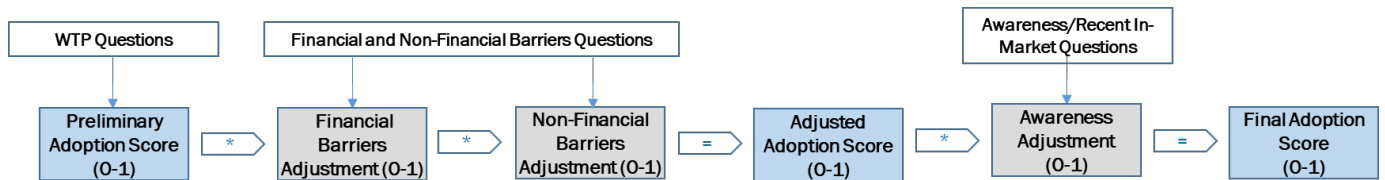
### 3.6 Adoption Curve Methodology

Adoption rate calculations were based on a battery of questions which assessed (1) the respondent's willingness to adopt energy efficiency technologies or participate in demand response programs in scenarios with varying levels of program support, (2) the magnitude of the respondent's financial and non-financial barriers to adoption/participation, and (3) their awareness of DESC energy efficiency programs and/or high

efficiency technologies. Equation 1 illustrates how the different types of survey responses were combined to develop the current residential adoption curves.

Current adoption rates are shown in Section 9.

Equation 1. Adoption curve equation



The Study Team developed estimates based on two residential customer segmentations: (1) single family vs. multifamily, and (2) low income vs. non-low income. All results are based on responses to the online residential customer survey.

### 3.6.1 Measures Covered by Primary Research

The Study Team developed adoption curves for the energy efficiency measures and DR programs shown in Table 8.

Table 8. Measures/Programs Included in Primary Research

Measures/program	Applicability
<b>EE equipment</b>	
Heating/CAC system HP water heater Insulation/air sealing	Residential customers and multifamily owners/managers who have decision-making authority over the enduse/measure
<b>DR programs</b>	
Winter/summer Smart Thermostat Program	Residential customers who have central air conditioning and/or compatible heating equipment and have decision-making authority over the enduse/measure
Winter/summer Time-of-Day Rate Program	Residential customers who are individually billed

### 3.6.2 Adoption Curve Inputs

Adoption curves are based on three types of survey questions: (1) willingness-to-participate (WTP) at different incentive levels, (2) barriers to adopting energy-efficient equipment, and (3) awareness of DESC programs.

#### Willingness-to-Participate

Direct WTP questions are the starting point of measure/program-specific adoption curve calculations. WTP questions focus on potential financial barriers to measure adoption/program participation. For each item, the team asked respondents to rate the likelihood that they would purchase the energy-efficient version of the equipment, or participate in the DR program, at various incentive levels, including no incentive and an incentive that covers the full incremental (or total) cost.

The scales for the WTP questions were five-point labeled scales. Table 9 shows the response options and the likelihood factor associated with each option. This likelihood factor represents the Preliminary Adoption Score for each survey respondent.

Table 9. Residential WTP response options and scoring

Response Option	Preliminary Adoption Score
1 – Not at all likely	0.00
2 – Slightly likely	0.25
3 – Somewhat likely	0.50
4 – Moderately likely	0.75
5 – Extremely likely	1.00

A small modification was applied to the direct WTP questions for the Time-of-Day Rate Program where all scenarios were mutually exclusive and not presented as necessarily increasingly appealing. This approach was a slight change from the other EE adoption scenarios.

### Barriers to Adoption

The survey presented respondents with common measure/program-specific financial and non-financial barriers to measure adoption/program participation and asked them to rate these barriers on a five-point labeled scale, where 1 means “Not a barrier,” 2 means “Slight barrier,” 3 means “Somewhat of a barrier,” 4 means “Moderate barrier,” and 5 means “Extreme barrier.”

The Study Team used a modified barrier methodology for the Smart Thermostat Program. The survey presented respondents with a list of common program-specific financial and non-financial barriers to program participation, but unlike other sections, respondents were not asked to rate these barriers. Instead, it asked them to indicate which barriers, if any, may stand in the way of their participation. If a respondent indicated at least one non-financial barrier for participating in the Smart Thermostat Program, the respondent's non-financial barrier ratings for the Time-of-Day Rate Program were used as a proxy. Likewise, respondents' financial barrier ratings for the Time-of-Day Rate Program were used as a proxy if they indicated at least one financial barrier for the Smart Thermostat Program.

Responses to financial and non-financial barrier questions were used to make adjustments to the Preliminary Adoption Score, if (1) the respondent identified at least one significant barrier (defined as a barrier that was given a response of 4 for a “Moderate barrier” or 5 for an “Extreme barrier”) and (2) their likelihood response to the WTP question for adoption without an incentive was greater than a 2 (i.e., more than “slightly likely”). Both financial and non-financial barrier adjustments were made on a stepwise scale because the barrier to choosing the efficient option is lessened as more of the incremental cost is covered.

Table 10 summarizes the financial and non-financial barrier adjustment factors at the different incentive levels covered in the survey for the equipment measures, Time-of-Day Rate Program, and Smart Thermostat Program. Note that residential barrier adjustment factor adjustment was held constant across all scenarios for the Time-of-Day Rate Program because the results do not reflect a true adoption curve. Since these adjustment factors are multiplied by the Preliminary Adoption Score, a lower factor means a greater adjustment. The adjustments for significant financial barriers are greater than for non-financial barriers because there is more of a contradiction between their WTP and barrier responses. For example, it would be a contradiction if a respondent indicated that a financial barrier was an “extreme barrier” to the adoption of the energy-efficient option but then also said that they would adopt the energy-efficient option without an incentive. The Study Team applied financial and non-financial barrier adjustments to the Preliminary Adoption Score to determine the Adjusted Adoption Score.

Table 10. Residential Barrier Adjustments

Incentive level	Financial barrier factor	Non-financial barrier factor
<b>EE equipment</b>		
0%	0.0	0.5
25%	0.2	0.6
50%	0.4	0.7
75%	0.6	0.8
100%	0.8	0.9
<b>Smart Thermostat Program</b>		
Annual incentive of \$0	0.5	0.5
Annual incentive of \$50	0.7	0.7
Annual incentive of \$75	0.9	0.9
<b>Time-of-Day Rate Program</b>		
20 cents/KWH on-peak rate, 10 cents/KWH off-peak rate	0.5	0.75
22 cents/KWH on-peak rate, 8 cents/KWH off-peak rate	0.5	0.75
24 cents/KWH on-peak rate, 6 cents/KWH off-peak rate	0.5	0.75
26 cents/KWH on-peak rate, 4 cents/KWH off-peak rate	0.5	0.75

### Awareness of DESC Programs

A final barrier to program participation is awareness of DESC's programs and the available incentives. Customers can only participate if they know that programs and incentives exist. The Adjusted Adoption Score represents the likely action of customers once they learn about the program/incentives. To reflect that some customers who might otherwise participate will not be aware of the program, the survey included two types of questions: (1) current awareness of DESC programs/incentives and (2) whether the respondent is a “recent market participant,” defined as having purchased/installed a similar measure in the past five years.

The Study Team developed an overall DESC program awareness adjustment based on the percentage of recent market participants who were aware of DESC programs/incentives at the time of the survey. The awareness adjustment is based on recent market participants, rather than all survey respondents, because some customers only become aware of the programs/offerings when they are in the market for a certain piece of equipment. For example, a respondent who does not know about the programs/incentives at the time of the survey, might find out about HVAC programs/incentives from a contractor if their HVAC system fails. As such, awareness of recent market participants better reflects the likely level of awareness at the time of decision-making around the installation of energy-efficient equipment and program participation.

The overall DESC program awareness adjustment was applied to all measure/program adoption curve calculations except for heat pump water heating. The Study Team developed a heat pump water heating technology awareness adjustment based on the percentage of participants with electric based water heating that indicated they were aware of heat pump water heaters prior to the survey.

The Final Adoption Score is derived from application of the awareness adjustment factor to the Adjusted Adoption Score results.

### **Aggregation Across Respondents**

For each measure/program, the team calculated overall self-reported adoption percentages as the average of all respondents' Final Adoption Scores. The Study Team developed aggregated adoption curves separately for Low Income and Non-Low Income as well as for Single Family and Multifamily. When calculating aggregated results, the team applied sample weights to adjust for oversampling of multifamily and low income customers.

## 4. Customer Characterization

As of Fall 2021, DESC had approximately 659,000 electric residential customers. The Study Team characterized these customers in the following ways:

- Low, Medium, and High electricity usage
- Whether they were weather sensitive
- Whether they were likely to use electric heat
- Low, Medium, and High electricity usage of weather-sensitive customers
- Historical participation

### 4.1 Usage Categorization

#### 4.1.1 Annualized Consumption (KWH)

The Study Team characterized the customer database by customers' electricity usage.

Table 11 outlines the distribution of usage levels, as defined by mean annualized consumption. Consumption at or within one standard deviation of the mean is categorized as medium consumption. <sup>3</sup> Anything below or above that is categorized as low and high, respectively, within the bounds described below. In the customer database, the team have flagged these usage categories:

- The medium usage level consists of all customers within +/- 1 standard deviation (SD) from the mean annualized consumption level. The majority of customers fall into this category by our design.
- The low category consists of customers below 1 SD, with a lower bound of 1,000. The Study Team excluded any customer who used less than 1,000 annualized KWH from our categorization, as DESC staff suggested that anything less than 1,000 annualized KWH likely indicated a vacant premise.
- The high category consists of customers above 1 SD of the mean but below 3 SDs of the mean.

Table 11. Distribution of annualized usage levels

Usage level	Range annualized KWH	Households	
		n	%
Low	1,000 – 6,136	44,575	11.09%
Medium	6,137– 21,819	305,287	76.00%
High	21,819– 37,501	46,984	11.69%
Mean	13,977 KWH	n/a	n/a

Note: Percentages do not sum to 100% due to excluding outliers above 3 SDs of the mean and customers below 1,000 annualized KWH.

<sup>3</sup> We first excluded outliers to calculate our mean and standard deviation, which was any customer above 37,501.36 KWH. However, these outliers are added back into the high category since they represent extremely high usage.

Table 12 presents residential customers with low and high annualized usage by customer segment from the residential customer database. When comparing low usage customers versus high usage customers, low users more often live in low income areas (26% vs 16%) and in multifamily homes (41% vs 4%). High usage customers are more often live in single family homes (96% vs 59%).

**Table 12. Low and high annualized usage by customer segment**

Usage Categories	% living in low income areas	% living in single family homes	% living in multifamily homes
Low Usage	26%	59%	41%
High Usage	16%	96%	4%

#### 4.1.2 Annualized Consumption Per Square Foot (KWH/SQFT)

Annualized consumption per square foot provides additional detail on electric usage for residential households. In this section, the team summarizes electricity usage per square foot for residential customers, providing an additional layer of information for DESC to target residential customers with future DSM programs.

The team obtained square footage data for all of the counties within DESC territory from CRS Data. CRS Data maintains a database of county level tax assessor data for all residential and nonresidential addresses available. This data received; however, had multiple data quality issues, such as:

- Not every address provided by CRS Data had tax assessor square foot data
- The dataset did not include new construction, as there is a one-year lag between construction completion and tax assessment
- COVID-19 impacted the collection of tax assessment data across multiple counties in South Carolina, thus not all square footage reported was up to date
- Data included both residential and commercial addresses within the same file and some addresses appeared to have both residential and commercial square footage within the same physical address.

Given the outlined issues, the team was able to map square footage data to a subset of residential customers (275,497 in total). Of the residential customers with square footage data, 175,081 had valid annualized kWh data. The team calculate average annualized consumption per square foot for those records that both had square footage and annualized kWh data.

Table 13 summarizes the average annualized consumption per square foot for residential customers overall and by income and housing type.

- Overall residential customers use about 8.04 KWH/SQFT. In addition, the minimum KWH/SQFT was less than 1.0 and the maximum KWH/SQFT was 135.67. The standard deviation was 4.36.
- Low Income customers have higher average KWH/SQFT (10.05) than non-low income customers (7.72).

Table 13. Average annualized consumption per square foot

	n	Average annualized consumption per square foot (KWH/SQFT)
Overall	175,081	8.04
<b>Income status</b>		
Non-low income	150,934	7.72
Low income	24,147	10.05
<b>Housing type</b>		
Single family	167,882	8.05
Multifamily	7,199	7.91

## 4.2 Load Disaggregation

The Study Team leveraged advanced analytics to perform a load disaggregation of the customer consumption data to identify customers with electricity usage that was weather sensitive to cold weather. Specifically, weather sensitive customers displayed a statistically significant relationship between their electricity consumption and colder outdoor temperatures (n =185,605, Table 14).

The Study Team ran many regression models for each individual customer before selecting the best model to describe each customer's electricity usage. The team specified separate models for heating only, cooling only, heating and cooling, and base load only (essentially re-specifying the model to drop or include weather terms and running it again for that customer). The separate models are estimated using heating degree days and cooling degree days (HDD and CDD, respectively) calculated with different setpoints (65 °F, 70 °F, etc.) to find the best setpoint for each house.<sup>4</sup> For customers whose best model included statistically significant heating terms, the team considered their load to be weather sensitive. The Study Team have flagged this variable in the customer database. To conduct this analysis the team modified source code developed as part of the MIT-licensed open-source platform OpenEEmeter.<sup>5</sup>

Table 14. Percentage of weather sensitive customers by segment

	n in model	% Weather Sensitive
Overall	349,289	53.00%
<b>Income status</b>		
Non-low income	283,992	51.15%
Low income	65,297	60.95%
<b>Housing type</b>		
Single family	289,368	52.55%
Multifamily	59,921	55.09%

Note: Percentage modeled, outliers removed

<sup>4</sup> Heating degree days measure how cold it is outside, as compared to a temperature setpoint. For example, if a given setpoint is 65 °F, and it is 40 °F on average on one day, that day has 25 HDD. Likewise, cooling degree days measure how hot it is outside compared to a setpoint. If a setpoint is 65 °F, and a day is on average 80 °F, that day has 15 CDD. [https://www.eia.gov/energyexplained/units-and-calculators/degree-days.php#:~:text=Heating%20degree%20days%20\(HDD\)%20are,for%20the%20two%2Dday%20period.](https://www.eia.gov/energyexplained/units-and-calculators/degree-days.php#:~:text=Heating%20degree%20days%20(HDD)%20are,for%20the%20two%2Dday%20period.)

<sup>5</sup> OpenEEmeter Contributors. "EEmeter: Tools for Calculating Metered Energy Savings." OpenEE. <http://eemeter.openee.io/>

The team was then able to discern among weather-sensitive customers, those who were likely to have electric heating (n = 100,478, Table 15) by screening model parameters for those indicative of a stronger relationship between heating degree days and electricity consumption. The Study Team flagged this weather sensitive variable in the customer database.

**Table 15. Percentage of weather sensitive electric heat likely customers by segment**

	n in model	% of electric heat likely
Overall – electric heat likely	100,478	28.77%
<b>Income status</b>		
Non-low income – electric heat likely	283,992	28.32%
Low income – electric heat likely	65,297	30.72%
<b>Housing type</b>		
Single family – electric heat likely	289,368	30.27%
Multifamily – electric heat likely	59,921	22.23%

The Study Team also investigated the heating setpoints of the weather-sensitive customers. Heating setpoints in heating degree day calculations are the temperature at which the HVAC system will maintain the heating in the space controlled by the thermostat. The setpoint determines at what temperature the heat turns on.

- 50% of DESC weather-sensitive customers have a setpoint of 70°F or higher
- The mean setpoint is 64°F
- The maximum is 90°F and the minimum is 39°F.

Table 16 shows the number of unique accounts across different temperature setpoints. The Study Team collapsed across some temperature ranges for ease of reading.

Table 16. Heating setpoints of weather-sensitive customers

Heating setpoints	Unique account IDs	Cumulative percent
75 and above	876	0.5%
74	22,638	14.6%
73	24,901	30.0%
72	10,591	36.6%
71	16,945	47.1%
70	4,998	50.2%
69	1,596	51.2%
68	1,935	52.4%
67	3,105	54.4%
66	5,084	57.5%
65	6,947	61.8%
64	12,628	69.7%
63	8,653	75.0%
62	8,203	80.1%
61	10,772	86.8%
60 and below	21,244	100%

## 4.3 Historical Participation

The Study Team merged available participation data from PY1–PY11 with the customer database and assessed historical participation of DESC’s customers. In total, the team matched 131,225 customers’ participation data (participant or non-participant) with account data. Table 17 outlines participation by segment. The Study Team appended the customer database with historical participation to indicate whether the customer has participated in various program types.

- 117,589 DESC Residential Customers (18% of total residential customers) were identified as past participants. This total does not include the seven million bulbs that customers purchased when DESC had a retail store program as those bulbs cannot be tracked to customer account numbers.

Table 17. Historical participation counts

	n	Participant	Non-participant
Overall	658,999	117,589	541,410
<b>Income status</b>			
Non-low income	527,774	94,774	433,000
Low income	131,225	22,815	108,410
<b>Housing type</b>			
Single family	504,949	106,485	398,464
Multifamily	154,050	11,104	142,946

Note: Percentages are created from the total number of Dominion Energy customers (n = 658,999).

The next four tables (Table 18, Table 19, Table 20 and Table 21) present the percentage of DESC customers in each segment that participated in each type of DSM program. This data includes historical data from PY1 through PY11. Eighteen percent of DESC's current residential customers participating in a past program.

- Overall, the Heating and Cooling – HVAC program and the HER program had the highest levels of participation across all DESC customers (5.13% for both).
- The Neighborhood Energy Efficiency Program had the largest share of participation for the low income and multifamily segments (6.73% and 3.04%, respectively).
- The Heating and Cooling – HVAC program the highest levels of participation for non-low income and single family customers (6.04% and 6.43%).

Table 18. Historical participation for heating and cooling programs

	N	Heating and cooling – HVAC	Heating and cooling – duct	Heating and cooling – water	Heating and cooling – efficiency improvements	Heating and cooling – water new home
Overall	658,999	5.13%	0.77%	0.60%	0.07%	0.02%
<b>Income status</b>						
Non-low income	527,774	6.04%	0.88%	0.71%	0.08%	0.02%
Low income	131,225	1.49%	0.31%	0.19%	0.04%	0.02%
<b>Housing type</b>						
Single family	504,949	6.43%	0.98%	0.70%	0.09%	0.02%
Multifamily	154,050	0.86%	0.06%	0.31%	0.01%	0.00%

Note: Percentages are created from the total number of DESC customers in each segment.

Table 19. Historical participation for lighting programs

	N	Residential lighting – business office lighting (BOL)	Residential lighting – online store	Residential lighting – free LED
Overall	658,999	1.60%	1.63%	0.16%
<b>Income status</b>				
Non-low income	527,774	1.28%	1.81%	0.03%
Low income	131,225	2.91%	0.89%	0.71%
<b>Housing type</b>				
Single family	504,949	1.79%	2.02%	0.19%
Multifamily	154,050	0.98%	0.34%	0.06%

Note: Percentages are created from the total number of DESC customers in each segment.

Table 20. Historical participation for neighborhood programs

	N	Neighborhood Energy Efficiency Program	Neighborhood Energy Efficiency Program - Mobile Homes
Overall	658,999	2.05%	0.05%
<b>Income Status</b>			
Non-low income	527,774	0.89%	0.02%
Low income	131,225	6.72%	0.18%
<b>Housing Type</b>			
Single family	504,949	1.73%	0.06%
Multifamily	154,050	3.09%	0.01%

Note: Percentages are created from the total number of DESC customers in each segment.

Table 21. Historical participation for other residential programs

	N	HER	HEC	Appliance Recycling Program	Home Performance with ENERGY STAR®*	ENERGY STAR® - New Construction†
Overall	658,999	5.13%	2.33%	2.20%	0.08%	0.08%
<b>Income status</b>						
Non-low income	527,774	5.47%	2.41%	2.31%	0.09%	0.10%
Low income	131,225	3.76%	1.74%	1.75%	0.04%	0.01%
<b>Housing type</b>						
Single family	504,949	6.37%	2.77%	2.73%	0.10%	0.10%
Multifamily	154,050	1.09%	0.66%	0.46%	0.01%	0.00%

Note: Percentages are created from the total number of DESC customers in each segment.

\*The Home Performance with ENERGY STAR® program ended in 2016

†The ENERGY STAR, New Construction program ended in 2016

The Study Team examined the breakdown of current participants and non-participants by segment. Participants and non-participants both live in low income areas about the same percentage of the time. However, non-participants are more likely to live in multifamily homes (26% vs 9%) (Table 22).

Table 22. Participation by Segment

Participation Status	% living in low income areas	% living in single family homes	% living in multifamily homes	% in urban area	% in suburban area	% in rural area
Participants	19%	91%	9%	51%	31%	18%
Non-Participants	20%	74%	26%	53%	29%	18%

## 4.4 Conclusion

In this section, The Study Team presents a summary of the customer characterization findings. The team triangulates the data on customer usage, weather sensitivity, electric heat likelihood and historical program participation.

Table 23 and Table 24 present the breakdown of low and high usage categories by weather sensitivity, electric likelihood and participation. Not surprisingly, high users are more weather sensitive and likely to have electric heat. In addition, current high usage customers are more often participants than low users.

Table 23. Usage by weather sensitivity and electric heat likelihood

Usage Categories	Total Modeled	Number Weather Sensitive	% Weather Sensitive	Number Electric Heat Likely	% Electric Heat Likely
Low Usage	36,729	16,775	46%	6,885	19%
High Usage	43,610	25,448	58%	14,753	34%

Table 24. Usage by historical participation

Usage Categories	Total N	Number Participants	% of Participants	Number of Non—Participants	% of Non—Participants
Low Usage	44,575	6,444	14%	38,131	86%
High Usage	46,984	11,688	25%	35,296	75%

The Study Team had the opportunity to further classify low and high users by those who live in low income areas. Similarly to all users, low users in low income areas are less weather sensitive comparatively than high users. However, the magnitude of their weather sensitivity increases as you look just at high users in low income areas. Seventy-one percent of high users in low income areas are weather sensitive (Table 25).

In Table 26, historical participation remains higher among high usage customers even living in low income areas than those with low usage.

Table 25. Usage in low income areas by weather sensitivity and electric heat likelihood

Usage Categories	Total Modeled	Number Weather Sensitive	% Weather Sensitive	Number Electric Heat Likely	% Electric Heat Likely
Low Usage – Low Income	9,012	4,464	50%	1,762	20%
High Usage- Low Income	6,736	4,756	71%	2,570	38%

Table 26. Usage in low income areas by historical participation

Usage Categories	Total N	Number Participants	% of Participants	Number of Non—Participants	% of Non—Participants
Low Usage – Low Income	11,447	1,900	17%	9,547	83%
High Usage – Low Income	7,410	1,780	24%	5,630	76%

## 5. Awareness, Concern, and Other Barriers

### 5.1 Current Program Awareness

The Study Team asked respondents to indicate if they had heard of a variety of DESC energy efficiency program offerings. ). Table 27 presents the percentage of respondents aware of each offering by customer segment.

- Overall awareness of DESC energy efficiency programs ranges from 14% to 46%.
- Program awareness for the Home Energy Check-Up program, Appliance Recycling Program, EnergyWise Online Savings Store, and duct work have increased since 2016.
- A larger percentage of non-low income respondents indicated being aware of all DESC program offerings, with the exception of the Neighborhood Energy Efficiency Program, which more low income respondents were aware of (19%) than non-low income respondents (12%).
- Overall, single family respondents were more aware of DESC program offerings than multifamily respondents. Single family respondents were significantly more aware of the Home Energy Check-Up Program (49%), rebates for ENERGY STAR®-certified heating/cooling through the Heating and Cooling Program (50%), and Appliance Recycling Program (44%) than multifamily respondents (37%, 34%, and 35% respectively).
- Overall awareness across all programs averaged around 40%, except for awareness of the Neighborhood Energy Efficiency Program (NEEP) (14%) and rebates for installing new duct work or improving existing duct work through the Heating & Cooling Program (23%). This level of awareness is not surprising, especially for NEEP. The marketing and outreach for NEEP is targeted to specific communities and low income customers.
- Since 2016, general awareness of DESC rebates and incentives, awareness of incentives for new HVAC, and awareness of the NEEP program remained the same at 40%, 46% and 14%. Home Energy Check Up Program awareness increased from 36% to 46% (10%), Appliance Recycling Program awareness increased from 35% to 42% (7%), EnergyWise Online Savings Store awareness increased from 25% to 42% (17%), and incentives for duct work awareness increase from 15% to 23% (8%). Table 27. DESC energy efficiency program awareness

## Awareness, Concern, and Other Barriers

	n	Aware of DESC rebates and incentives	Aware of the Home Energy Check-Up Program	Aware of rebates for installing a new, ENERGY STAR®-certified heating or cooling system through the Heating & Cooling Program	Aware of rebates for installing new duct work or improving existing duct work through the Heating & Cooling Program	Aware of the EnergyWise Online Savings Store	Aware of the Neighborhood Energy Efficiency Program	Aware of the Appliance Recycling Program
Overall	376 - 414	40%	46%	46%	23%	42%	14%	42%
Income status								
Non-low income (a)	270 - 287	44% <sup>b</sup>	49%	53% <sup>b</sup>	23%	44%	12%	43%
Low income (b)	127 - 112	33%	42%	32%	21%	37%	19%	40%
Housing type								
Single family (c)	282 - 311	41%	49% <sup>d</sup>	50% <sup>d</sup>	25%	43%	14%	44% <sup>d</sup>
Multifamily (d)	85 - 103	37%	37%	34%	17%	37%	13%	35%

Note: Results based on web survey data

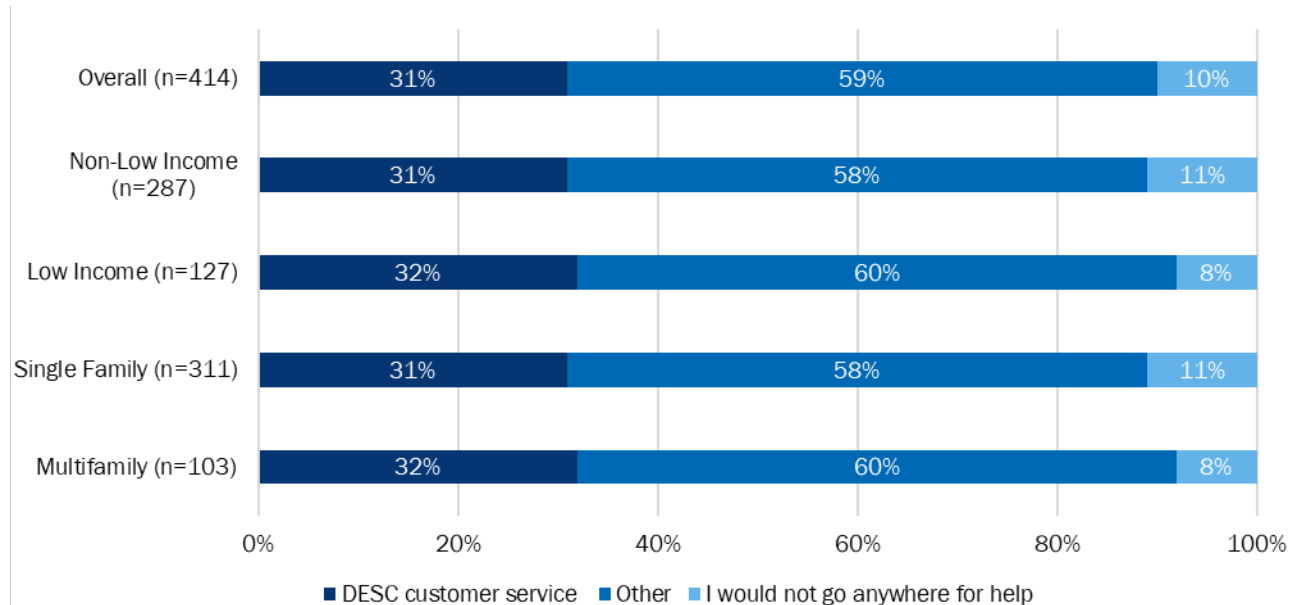
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

*Awareness, Concern, and Other Barriers*

Respondents were also asked where they would be most likely to seek assistance if they were unable to pay their monthly energy bill. Figure 2 presents the percentage of respondents who would seek assistance from DESC customer service versus other sources.

- Across all customer segments, respondents reported seeking assistance from DESC customer service at a similar rate (31% overall).
- The two other resources respondents indicated going to for assistance at the highest rate were family/friends (26% overall) and a credit card (21% overall).
- Low income respondents reported they would seek assistance from social services at a significantly higher rate (11%) than non-low income respondents (0%). Non-low income respondents reported they would seek assistance from a credit card at a significantly higher rate (27%) than non-low income respondents (10%).

Figure 2. Assistance with monthly energy bill



Note: Results based on web survey data a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 5.2 Decision-Making and Demographics

The Study Team asked respondents what type of residence their home was. Table 28 presents the percentage of respondents who indicated each housing type, broken down by customer segment.

- Most respondents indicated living in a single family detached residence (65%), followed by an apartment, multifamily, co-op, or condominium (17%), mobile/manufactured home (10%), and duplex or townhome (7%).
- Non-low income respondents were significantly more likely than low income respondents to indicate that they lived in a single family detached residence.
- Low income respondents were significantly more likely than non-low income respondents to indicate that they lived in a mobile/manufactured home.

Table 28. Housing type

	n	Single-family detached residence	Duplex or townhome	Apartment, multi-family, co-op, or condominium	Mobile/manufactured home
Overall	414	65%	7%	17%	10%
<b>Income status</b>					
Non-low income (a)	287	70% <sup>b</sup>	8%	17%	5%
Low income (b)	127	55%	7%	18%	20% <sup>a</sup>
<b>Housing type</b>					
Single family (c)	311	86%	0%	0%	14%
Multifamily (d)	103	0%	30%	70%	0%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Respondents who indicated they lived in an apartment, multifamily, co-op, or condominium were asked how many units there were in the building. Table 29 presents the percentage of respondents who indicated each range of units, broken down by customer segment.

- Among respondents who lived in buildings with multiple units, most lived in three- to nine-unit buildings (41%), followed by 30 or more units (31%), 10 to 29 units (15%), and 2 units (13%).
- Non-low income respondents were more likely than low income respondents to indicate their building had 30 or more units.

Table 29. Number of units

	n	2 units	3-9 units	10-29 units	30 or more units
Overall	100	13%	41%	15%	31%
<b>Income status</b>					
Non-low income (a)	54	11%	37%	15%	37% <sup>b</sup>
Low income (b)	46	17%	48%	15%	20%

Note: Results based on web survey data; respondents who indicated living in an apartment, multifamily, co-op, or condominium

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how many people in different age groups resided in their home. Table 30 presents the average number of occupants in the home, broken down by customer segment.

- The average number of occupants in respondents' homes was 2.42 occupants.
- Low income and single family respondents indicated significantly more occupants in their homes than their counterparts.

Table 30. Household occupancy

	n	Occupants
Overall	414	2.42
<b>Income status</b>		
Non-low income (a)	287	2.17
Low income (b)	127	2.90 <sup>a</sup>
<b>Housing type</b>		
Single family (c)	311	2.54 <sup>d</sup>
Multifamily (d)	103	2.05

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Table 31 presents the percentage of respondents who indicated having children and/or seniors in their household, broken down by customer segment. Can ODC add statement here of the significant of knowing who has children and elderly in the home?

- Overall, 29% of respondents indicated having children in the home and 32% indicated having elderly occupants in the home.
- Low income respondents were significantly more likely than non-low income respondents to indicate having children in the home.
- Single family respondents were significantly more likely than multifamily respondents to indicate having elderly occupants in the home.

Table 31. Children and elderly in home

	n	Has children	Has elderly
Overall	413	29%	32%
<b>Income status</b>			
Non-low income (a)	287	23%	30%
Low income (b)	127	39% <sup>a</sup>	36%
<b>Housing type</b>			
Single family (c)	310	30%	37% <sup>d</sup>
Multifamily (d)	103	24%	16%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents to indicate what range their total annual household income from all sources in 2020, before taxes. Table 32 presents the percentage of respondents who indicated each income range, broken down by customer segment.

- Overall, 15% of respondents indicated that their annual household income in 2020 before taxes was less than \$20,000. Approximately two-fifths (42%) of respondents indicated their income was between \$20,000 and \$69,999, and 35% of respondents indicated their income was between \$75,000 and \$149,999. Few respondents indicated their income was between \$150,000 and \$199,999 (3%) or more than \$200,000 (5%).
- Single family respondents were more likely than multifamily respondents to indicate their household made \$200,000 or more a year before taxes. There were no other significant differences in income based on housing type.

Table 32. Household income

	n	Less than \$20,000	\$20,000 to \$39,999	\$40,000 to \$59,999	\$60,000 to \$74,999	\$75,000 to \$99,999	\$100,000 to \$149,999	\$150,000 to \$199,999	\$200,000 or more
Overall	353	15%	24%	18%	11%	10%	14%	3%	5%
Housing type									
Single family (c)	260	14%	22%	17%	11%	11%	15%	4%	6% <sup>d</sup>
Multifamily (d)	93	18%	27%	22%	11%	8%	11%	1%	1%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents what periods of time during the day their household was occupied on weekdays and the weekend. Time of occupancy is analyzed to determine what hours of the day residents are likely to be home and using energy consuming technology. Differences in hours of occupancy between customer segments also suggests potential differences in energy consumption behavior based on housing type and income. Table 33 presents the percentage of respondents who indicated their home was occupied at a given time **on weekdays**, broken down by customer segment.

- Overall, respondents indicated the home being occupied most from 4:00 p.m. to 8:00 a.m. (4:00 p.m.–8:00 p.m. [84%], 8:00 p.m.–12:00 a.m. [88%], 12:00 a.m.–4:00 a.m. [87%], 4:00 a.m.–8:00 a.m. [82%]), followed by 8:00 a.m. to 4:00 p.m. (8:00 a.m.–12:00 p.m. [68%], 12:00 p.m.–4:00 p.m. [61%]).
- Non-low income respondents were significantly more likely than low income respondents to indicate that their household was occupied at 8:00 p.m. to 12:00 a.m. and 12:00 a.m. to 4:00 a.m.
- Single family respondents were significantly more likely than multifamily respondents to indicate that their household was occupied at 8:00 a.m. to 12:00 p.m., 12:00 p.m. to 4:00 p.m., and 4:00 a.m. to 8:00 a.m.

Table 33. Household occupancy on weekdays

	n	8 am - 12 pm	12 pm - 4 pm	4 pm - 8 pm	8 pm - 12 am	12 am - 4 am	4 am - 8 am	Part-time home
Overall	414	68%	61%	84%	88%	87%	82%	3%
<b>Income status</b>								
Non-low income (a)	287	70%	61%	85%	90% <sup>b</sup>	90% <sup>b</sup>	84%	2%
Low income (b)	127	63%	62%	83%	84%	83%	78%	4%
<b>Housing type</b>								
Single family (c)	311	72% <sup>d</sup>	65% <sup>d</sup>	85%	89%	88%	85% <sup>d</sup>	3%
Multifamily (d)	103	57%	49%	82%	85%	87%	74%	2%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Table 34 presents the percentage of respondents who indicated their home was occupied at a given time on weekends, broken down by customer segment.

- Overall, most respondents indicated the home being occupied the entire day (80%–89% across time ranges), with the time frame most respondents indicated the home being unoccupied being 12:00 p.m. to 4:00 p.m. (80%).
- Non-low income respondents were significantly more likely than low income respondents to indicate that their household was occupied at 12:00 a.m. to 4:00 a.m.
- Single family respondents were significantly more likely than multifamily respondents to indicate that their household was occupied at 12:00 p.m. to 4:00 p.m., 4:00 p.m. to 8:00 p.m., and 4:00 a.m. to 8:00 a.m.

Table 34. Household occupancy on weekends

	n	8 am - 12 pm	12 pm - 4 pm	4 pm - 8 pm	8 pm - 12 am	12 am - 4 am	4 am - 8 am	Part-time home
Overall	414	89%	80%	83%	87%	89%	86%	3%
<b>Income status</b>								
Non-low income (a)	287	91%	80%	83%	88%	91% <sup>b</sup>	88%	3%
Low income (b)	127	86%	78%	84%	84%	83%	83%	3%
<b>Housing type</b>								
Single family (c)	311	90%	83% <sup>d</sup>	86% <sup>d</sup>	87%	89%	88% <sup>d</sup>	3%
Multifamily (d)	103	87%	69%	76%	85%	88%	82%	3%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents whether they owned or rented their current home . Table 35 presents the percentage of owners and renters, broken down by customer segment.

- Overall, 67% of respondents were owners and 33% were renters.
- Non-low income and single family respondents were significantly more likely than their counterparts to indicate they owned their home.
- Low income and multifamily respondents were significantly more likely than their counterparts to indicate they rented their home.

Table 35. Owner/renter status

	n	Owner	Renter
Overall	414	67%	33%
<b>Income status</b>			
Non-low income (a)	287	76% <sup>a</sup>	24%
Low income (b)	127	50%	50% <sup>b</sup>
<b>Housing type</b>			
Single family (c)	311	82% <sup>d</sup>	18%
Multifamily (d)	103	24%	76% <sup>c</sup>

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Except for respondents who indicated their residence was a single family detached home they own, the team asked respondents who the primary decision-maker was for upgrading insulation/air sealing, installing/replacing heating or cooling systems, installing/replacing thermostats, and installing/replacing major appliances. If the respondent indicated owning their single family detached home, it was assumed they had the decision-making authority for all the upgrades. Table 36 presents decision-making authority broken down by owner renter status and customer segment.

- Overall, owners were more likely than renters to indicate that they had the decision-making authority over all energy efficiency upgrades (99%–100% vs. 9%–22%, respectively).
- The type of energy efficiency upgrades most renters indicated having decision-making authority over was installing/replacing major appliances (22%), followed by upgrading insulation/air sealing (14%), and installing/replacing thermostats (13%). Few renters indicated having the authority to make decisions about installing/replacing heating or cooling systems (9%).
- Across renters, low income and single family respondents were significantly more likely than their counterparts to indicate they had decision-making authority over all listed energy efficiency upgrades.

Table 36. Owner/renter status and decision-making authority

	Owner					Renter				
	n	Upgrading insulation/air sealing	Installing/replacing heating or cooling systems	Installing/replacing thermostats	Installing/replacing major appliances	n	Upgrading insulation/air sealing	Installing/replacing heating or cooling systems	Installing/replacing thermostats	Installing/replacing major appliances
Overall	284	99%	100%	100%	100%	128	14%	9%	13%	22%
<b>Income status</b>										
Non-low income (a)	228-229	99%	99%	99%	99%	56-57	8%	1%	6%	12%
Low income (b)	55	100%	100%	100%	100%	69-71	21% <sup>a</sup>	17% <sup>a</sup>	19% <sup>a</sup>	32% <sup>a</sup>
<b>Housing type</b>										
Single family (c)	261	100%	100%	100%	100%	48-49	26% <sup>d</sup>	18% <sup>d</sup>	24% <sup>d</sup>	45% <sup>d</sup>
Multifamily (d)	21-23	90%	95%	95%	95%	77-79	6%	3%	4%	6%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how much their monthly DESC electric bill was, on average. Table 37 presents respondents' average self-reported electric bill broken down by customer segment.

- Respondents' average self-reported monthly DESC bill was \$176.
- Low income and single family respondents had significantly higher monthly self-reported electric bills than their counterparts.

Table 37. Self-reported average Dominion Energy South Carolina electric bill

	n	DESC bill
Overall	340	\$176
<b>Income status</b>		
Non-low income (a)	237	\$165
Low income (b)	103	\$196 <sup>a</sup>
<b>Housing type</b>		
Single family (c)	258	\$195 <sup>d</sup>
Multifamily (d)	82	\$115

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents what percentage of their monthly household expenses went to energy usage. Table 38 presents the average percentage of household expenses that respondents felt went to energy usage, broken down by customer segment.

- The average percentage of monthly household expenses respondents felt went to energy usage was 30%.
- Low income respondents indicated they felt that energy usage accounted for a significantly larger portion of their monthly household expenses than non-low income respondents.

Table 38. Self-reported percentage of household expenses going to energy usage

	n	Percentage of expenses
Overall	153	30%
<b>Income status</b>		
Non-low income (a)	103	21%
Low income (b)	50	48% <sup>a</sup>
<b>Housing type</b>		
Single family (c)	112	30%
Multifamily (d)	41	33%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents when their home was built. Respondents who could not estimate a year were asked to select a range. For those who selected a range, the year the home was built was calculated to be the midpoint of the selected range. Table 39 presents the average year respondents' homes were built broken down by customer segment.

- The average year respondents' homes were built was 1989. Average year built is similar to the baseline data collected in 2018 where the average year homes were built was 1988.
- Single family respondents' homes were significantly older on average than multifamily respondents' homes.

Table 39. Average year household was built

	n	Year built
Overall	340	1989
<b>Income status</b>		
Non-low income (a)	256	1990
Low income (b)	84	1987
<b>Housing type</b>		
Single family (c)	274	1987
Multifamily (d)	66	1997 <sup>c</sup>

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents the square footage of their home. Respondents who could not estimate the square footage of their home were asked to select a range. For those who selected a range, the square footage of the home was calculated to be the midpoint of the selected range. Table 40 presents the average square footage of respondents' homes broken down by customer segment.

- The average square footage of respondents' homes was 2,018 sq. ft.
- Single family respondents indicated having significantly larger homes than multifamily respondents.

Table 40. Average square footage

	n	Square footage
Overall	344	2,018
<b>Income status</b>		
Non-low income (a)	267	2,052
Low income (b)	77	1,913
<b>Housing type</b>		
Single family (c)	265	2,282 <sup>d</sup>
Multifamily (d)	79	1,195

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents in what year they were born. This value was used to compute their age as of survey analysis. Table 41 presents the average age of respondents broken down by customer segment.

- The average age of respondents was 52 years.
- Single family respondents were significantly older, on average, than multifamily respondents.

Table 41. Average age of survey respondent

	n	Age
Overall	324	52
<b>Income status</b>		
Non-low income (a)	220	53
Low income (b)	104	51
<b>Housing type</b>		
Single family (c)	247	55 <sup>d</sup>
Multifamily (d)	77	43

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents to indicate their highest level of educational attainment. Table 42 presents the average education level of respondents broken down by customer segment.

- Most respondents indicated that their highest level of education was a college degree (40%), followed by a postgraduate degree (22%), some college (20%), and a high school diploma (16%). Few respondents indicated their highest level of education being some high school (1%), or elementary (1%).
- Low income respondents were significantly more likely than non-low income respondents to indicate their highest level of education was some high school, a high school diploma, or some college.
- Non-low income respondents were significantly more likely than low income respondents to indicate their highest level of education was a college or postgraduate degree.

Table 42. Average education level

	n	Elementary	Some high school	High school graduate	Some college	College graduate	Postgraduate degree
Overall	386	1%	1%	16%	20%	40%	22%
<b>Income status</b>							
Non-low income (a)	272	0%	<1%	8%	17%	47% <sup>b</sup>	28% <sup>b</sup>
Low income (b)	114	2%	3% <sup>a</sup>	31% <sup>a</sup>	28% <sup>a</sup>	26%	10%
<b>Housing type</b>							
Single family (c)	293	1%	1%	16%	21%	39%	23%
Multifamily (d)	93	0%	1%	15%	20%	44%	19%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents if they were of Hispanic, Latino or Spanish descent. Table 43 presents the percentage of respondents who indicated being Hispanic, Latino, or Spanish broken down by customer segment.

- Overall, few respondents indicated being of Hispanic, Latino, or Spanish descent (1%).

Table 43. Ethnicity

	n	Of Hispanic, Latino or Spanish descent
Overall	370	1%
<b>Income status</b>		
Non-low income (a)	258	1%
Low income (b)	112	3%
<b>Housing type</b>		
Single family (c)	280	1%
Multifamily (d)	90	2%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents which race best described them. Table 44 presents the percentage of respondents who indicated each race broken down by customer segment.

- Most respondents indicated their race as White or Caucasian (66%), followed by Black or African American (32%), Asian (1%), American Indian (1%), and other (<1%).
- Non-low income and single family respondents were significantly more likely than their counterparts to indicate their race as White or Caucasian.
- Low income and multifamily respondents were significantly more likely than their counterpart to indicate their race as Black or African American.

Table 44. Race

	n	White or Caucasian	Black or African American	Asian	American Indian	Other
Overall	348	66%	32%	1%	1%	<1%
<b>Income status</b>						
Non-low income (a)	241	79% <sup>b</sup>	19%	<1%	1%	<1%
Low income (b)	107	41%	58% <sup>a</sup>	1%	0%	0%
<b>Housing type</b>						
Single family (c)	262	69% <sup>d</sup>	29%	1%	1%	0%
Multifamily (d)	86	58%	42% <sup>c</sup>	0%	0%	<1%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents to indicate the primary language spoken in their home. Table 45 presents the percentage of respondents that indicated each language broken down by customer.

- Most respondents indicated that the primary language spoken in their home was English (98%), followed by Spanish (1%), French (<1%), Chinese (<1%), and other (<1%).
- Low income respondents were significantly more likely than non-low income respondents to indicate that the primary language spoken in their home was Spanish.

Table 45. Primary language

	N	English	Spanish	French	Chinese	Other
Overall	403	98%	1%	<1%	<1%	<1%
<b>Income status</b>						
Non-low income (a)	280	99%	<1%	<1%	<1%	0%
Low income (b)	123	97%	2% <sup>a</sup>	0%	0%	1%
<b>Housing type</b>						
Single family (c)	304	98%	1%	<1%	<1%	0%
Multifamily (d)	99	99%	0%	0%	0%	1%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents to indicate their gender identity. Table 46 presents the percentage of respondents that indicated each gender broken down by customer segment.

- Most respondents indicated identifying as a woman (64%). The remaining respondents indicated identifying as a man (36%). A small percentage of respondents indicated identifying as gender-fluid (<1%) or nonbinary (<1%). The remaining respondents indicated identifying as a man (36%).
- Low income respondents were significantly more likely than non-low income respondents to indicate they identified as a woman.
- Non-low income respondents were significantly more likely than low income respondents to indicate they identified as a man.

Table 46. Gender

	n	Woman	Man	Gender-Fluid	Nonbinary
Overall	380	64%	36%	<1%	<1%
<b>Income Status</b>					
Non-low income (a)	262	54%	45% <sup>b</sup>	1%	<1%
Low income (b)	118	82% <sup>a</sup>	18%	<1%	0%
<b>Housing Type</b>					
Single family (c)	286	64%	35%	1%	<1%
Multifamily (d)	94	62%	38%	0%	0%

Note: Results based on web survey data

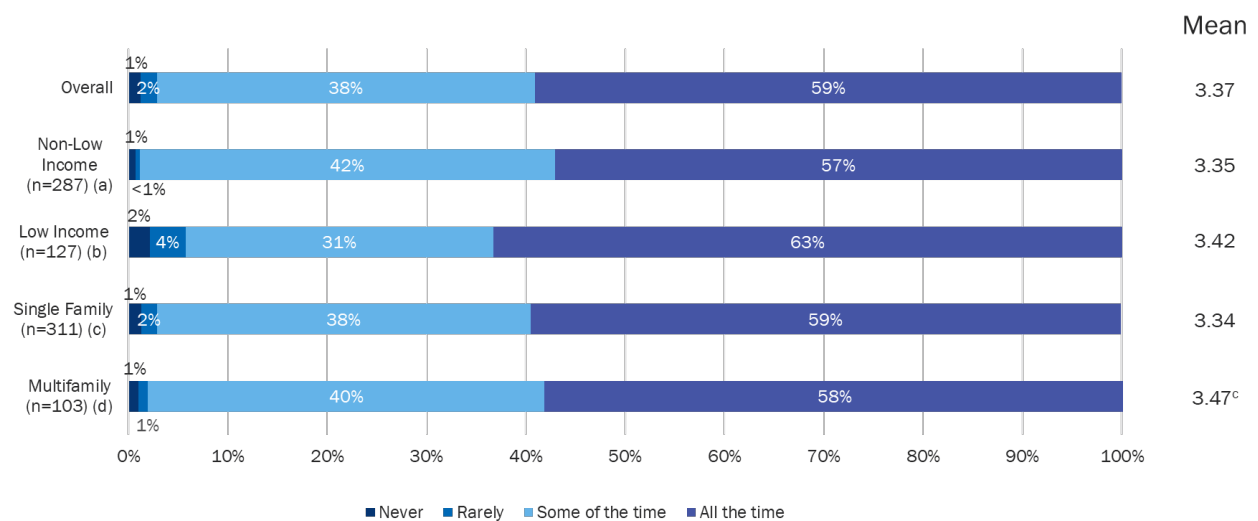
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

### 5.3 Energy Efficiency Intention and Concern

The Study Team asked respondents how often they made an effort to live in ways that reduced their home's electricity usage. Figure 3 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, nearly all respondents (97%) indicated that they made an effort to reduce their home's electricity usage "some" or "all the time."
- Multifamily respondents had a significantly higher mean score than single family respondents, indicating multifamily respondents made an effort to reduce their home's electricity usage more often than single family respondents.

Figure 3. Effort to reduce home's electricity usage



Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents which common expenses they were concerned about being able to pay. Table 47 presents the percentage of respondents that indicated being concerned about each expense, broken down by customer segment.

- Overall, respondents' most common concern was paying energy bills (41%), followed by buying groceries/household necessities (32%), paying health care bills (30%), paying rent or mortgage (27%), and paying for childcare (4%).
- Non-low income customers are the majority of customers, with 28% of all respondents indicating they equally concerned about paying for health care bills as they were for paying for energy bills,
- Low income respondents were more likely than non-low income respondents to be concerned about all expenses. Notably, low income respondents were significantly more likely to be concerned about paying rent or mortgage, paying energy bills, and buying groceries/household necessities.
- Multifamily respondents were more likely than single family respondents to be concerned about all expenses, with the exception of paying health care bills. Notably, multifamily respondents were significantly more likely than single family respondents to be concerned about paying rent or mortgage and paying for childcare.

Table 47. Expenses and concerns

	n	Paying rent/mortgage	Paying energy bills	Paying health care bills	Paying for childcare	Buying groceries or household necessities
Overall	414	27%	41%	30%	4%	32%
<b>Income status</b>						
Non-low income (a)	287	21%	28%	28%	3%	24%
Low income (b)	127	40% <sup>a</sup>	66% <sup>a</sup>	35%	5%	47% <sup>a</sup>
<b>Housing type</b>						
Single family (c)	311	24%	40%	31%	1%	31%
Multifamily (d)	103	37% <sup>c</sup>	45%	28%	11% <sup>c</sup>	34%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## LOW INCOME PRIMARY CONCERNS AND EXPENSES

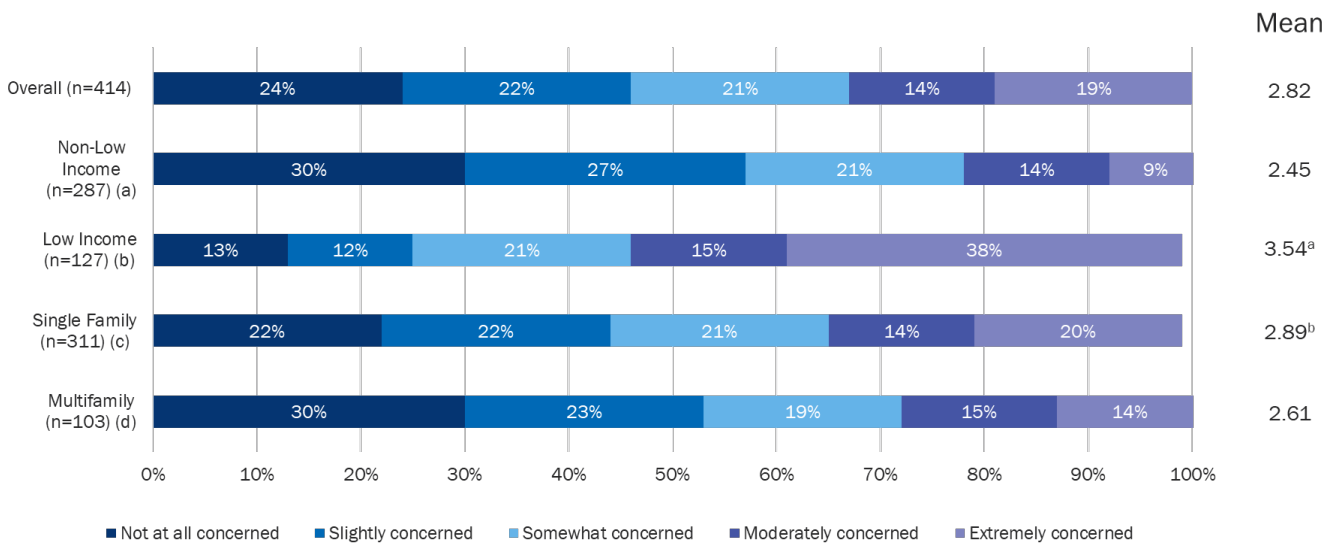
In our community leader interviews, most interviewees reported that low income residents prioritize their spending on everyday living expenses like rent, mortgage and utility bills, and daily essentials such as food and clothing. Leaders voiced that these necessities are of highest concern to low income residents, as many are living day-by-day to make ends meet.

*"I think when it comes down to basic needs, every human wants the safety first... safety comes in being able to stay in my home and not be out on the streets. So, I'm going to do whatever I can to stay there and then focus on the minimal comforts that I need, food, utilities, water, [etc.]"*  
(Charleston leader)

The Study Team asked respondents how concerned they were about affording their household's energy costs on a scale of 1 "not at all concerned" to 5 "extremely concerned." Figure 4 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, only slightly more than half (54%) of respondents indicated that they were at least "somewhat concerned" about their household energy costs, with 46% of respondents indicated they were "not at all concerned" or only "slightly concerned."
- Non-low income customers are the majority of customers, with 30% of all respondents indicating they were "not at all concerned" and 27% indicating they were only "slightly concerned."
- Low income and single family respondents were more likely than their counterparts to indicate they were at least slightly concerned about affording their household's energy costs.
- The mean score for all respondents was 2.82, suggesting that respondents' level of concern about affording energy costs falls slightly below "somewhat concerned."
- The mean score for low income respondents (3.54) was significantly higher than the mean score for non-low income respondents (2.45), indicating low income respondents were significantly more concerned about affording their household's energy costs than non-low income respondents.
- The mean score for single family respondents (2.89) was significantly higher than the mean score for multifamily respondents (2.61), indicating single family respondents were significantly more concerned about affording their household's energy costs than multifamily respondents.

Figure 4. Concern with affording household energy



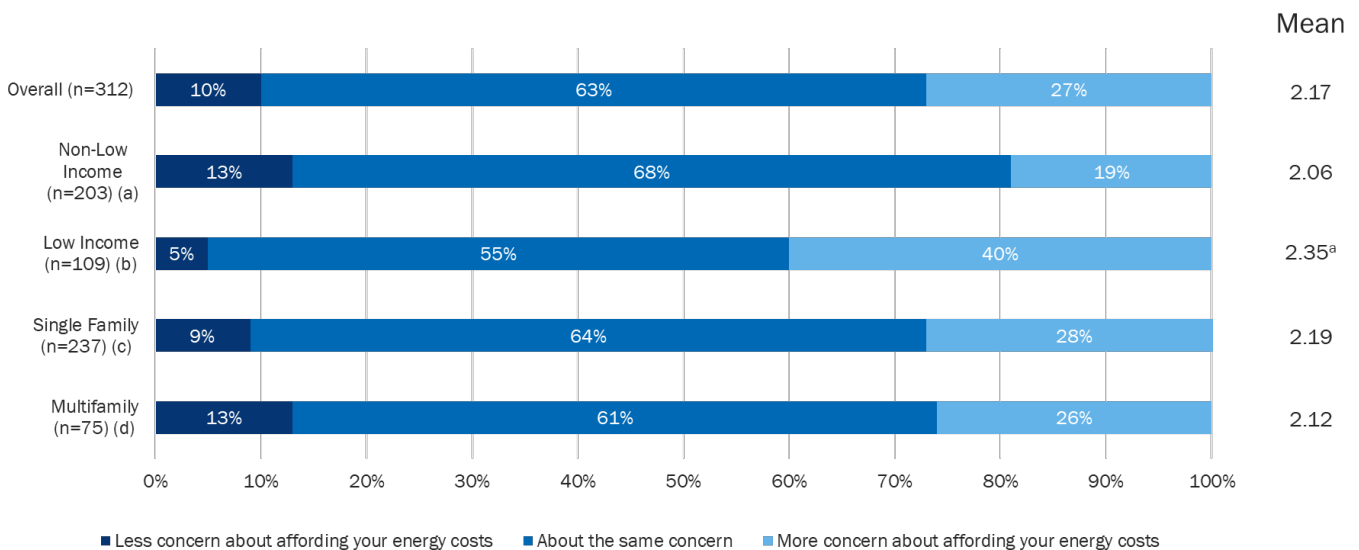
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Respondents who indicated they were at least “slightly concerned” about affording their household’s energy costs were asked how their concern about affording their energy costs compared to their concern about affording other household bills and expenses. This question was asked on a scale of 1 “less concern about affording your energy costs” to 3 “more concern about affording energy costs.” Figure 5 presents the frequency of each response by percentage, broken down by customer segment.

- Most respondents indicated they had the “same” or “less concern” about their energy costs than they did for their other household bills and expenses, with only 27% of respondents indicating that they had more concern about affording their energy costs.
- The overall mean score was 2.17, indicating that the average respondent’s answer to this question falls slightly above “about the same concern.”
- Low income respondents were more likely than non-low income respondents to indicate that they had “more concern” about affording their energy costs than concern about affording other household bills and expenses.
- The overall mean score was 2.17, indicating that the average respondent’s answer to this question falls slightly above “about the same concern.”
- The mean score for low income respondents (2.35) was significantly higher than the mean score for non-low income respondents (2.06), indicating low income respondents had more concern about affording their energy costs than their other household expenses compared to non-low income respondents.

Figure 5. Concern with energy costs compared to other expenses



Note: Results based on web survey data – respondents that were at least “slightly” concerned about energy costs

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how many months in the past year they had to reduce or go without basic household necessities to pay an energy bill. Table 48 presents the percentage of respondents that indicated prioritizing an energy bill over household necessities by number of months, broken down by customer segment.

- Most respondents indicated never reducing or going without basic household necessities to pay an energy bill (75%).
- Non-low income respondents were significantly more likely than low income respondents to indicate they had never forgone basic necessities to pay an energy bill.
- Just under 50% of low income customers had forgone basic necessities to pay an energy bill. With the exception of “10 to 12 months” low income respondents were significantly more likely than non-low income respondents to indicate they had forgone basic necessities to pay an energy bill for any number of months.
- Multifamily respondents were more likely than single family respondents to indicate they had forgone basic necessities to pay an energy bill for any number of months.
- Single family respondents were significantly more likely than multifamily respondents to indicate that they had never forgone basic necessities to pay an energy bill.

Table 48. Foregoing basic household necessities by segment

	n	10 to 12 months	7 to 9 months	4 to 6 months	1 to 3 months	Never
Overall	414	2%	2%	4%	17%	75%
<b>Income status</b>						
Non-low income (a)	287	2%	1%	2%	9%	86% <sup>b</sup>
Low income (b)	127	2%	4% <sup>a</sup>	8% <sup>a</sup>	33% <sup>a</sup>	53%
<b>Housing type</b>						
Single family (c)	311	2%	1%	3%	16%	78% <sup>d</sup>
Multifamily (d)	103	3%	3%	8% <sup>c</sup>	19%	68%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Respondents who received a stimulus check in 2020 and indicated they spent at least some of it were asked how they spent their stimulus money check. Table 49 presents the percentage of respondents who indicated they spent money on a variety of expenses, broken down by customer segment.

- Overall, the expense that most respondents indicated spending their stimulus money on was household essentials (52%), followed by paying down debt (30%), transportation (15%), home and equipment upgrades (14%), entertainment/non-essential spending (8%), and other expenses (2%).
- Low income respondents were more likely than non-low income respondents to indicate they had spent their stimulus money on household essentials, transportation, and paying down debt.
- Non-low income respondents were more likely than low income respondents to indicate they had spent their stimulus money on entertainment/non-essential spending and home and equipment upgrades.
- Multifamily respondents were more likely than single family respondents to indicate they had spent their stimulus money on entertainment/non-essential spending, household essentials, transportation, and paying down debt.
- Notably, non-low income and single family respondents were more likely to indicate they had spent their stimulus on home and equipment upgrades than low income and multifamily respondents respectively.

Table 49. Stimulus spending

	n	Entertainm ent/non- essential spending	Household essentials	Transportati on	Home and equipment upgrades	Paying down debt (credit cards/loans /past due amounts)	Other
Overall	345	8%	52%	15%	14%	30%	2%
<b>Income status</b>							
Non-low income (a)	233	11% <sup>b</sup>	43%	10%	15%	28%	2%
Low income (b)	112	2%	70% <sup>a</sup>	23% <sup>a</sup>	12%	34%	2%
<b>Housing type</b>							
Single family (c)	257	5%	52%	13%	16% <sup>d</sup>	29%	1%
Multifamily (d)	88	16% <sup>c</sup>	54%	20%	9%	34%	3%

Note: Results based on web survey data; respondents who received a stimulus check in 2020 and spent at least some of it

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Those respondents who indicated they had spent their stimulus money on home and equipment upgrades were asked more specifically what types of home and equipment upgrades they made with their stimulus money. Table 50 presents the percentage of respondents who indicated they spent the money on a variety of home and equipment upgrades, broken down by customer segment.

- Overall, the type of home/equipment upgrade most respondents indicated spending their stimulus money on was cosmetic home upgrades (5%), followed by critical home repairs (4%), equipment upgrades (2%), other home/equipment upgrades (2%), updates to heating and cooling (1%), upgrade/replacement of windows/insulation/siding (1%), and solar panels and/or battery storage (1%).
- Single family respondents were slightly more likely than multifamily respondents to indicate they had spent their stimulus money on cosmetic home upgrades, critical home upgrades, equipment upgrades, and upgrade/replacement of windows/insulation/siding.
- Non-low income respondents were slightly more likely than low income respondents to indicate they had spent their stimulus money on cosmetic home upgrades and equipment upgrades.
- Low income respondents were slightly more likely than non-low income respondents to indicate they had spent their stimulus money on critical home repairs.

Table 50. Stimulus spending - home and equipment upgrades

	n	Updates to heating and cooling equipment	Cosmetic home upgrades	Critical home repairs	Equipment upgrades	Upgrade/replacement of windows, insulation, or siding	Solar panels and/or battery storage	Other
Overall	346	1%	5%	4%	2%	1%	1%	2%
<b>Income status</b>								
Non-low income (a)	232	1%	6%	3%	3%	1%	1%	2%
Low income (b)	111	2%	3%	5%	1%	2%	0%	2%
<b>Housing type</b>								
Single family (c)	255	1%	6%	5%	3%	2%	<1%	2%
Multifamily (d)	88	1%	3%	1%	0%	0%	1%	2%

Note: Results based on web survey data – respondents that received a stimulus check in 2020 and spent at least some of it

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents, if they were to receive another stimulus check (\$1,000 for low income respondents and \$2,000 for non-low income respondents), how they would spend the money. Table 51 presents the percentage of respondents who indicated they would spend money on a variety of potential expenses, broken down by customer segments.

- Overall, respondents indicated they would be most likely to spend an additional stimulus check on household essentials (53%), followed by paying down debt (39%), home and equipment upgrades (16%), transportation (9%), savings (9%), entertainment/non-essential spending (5%), and other expenses (1%).
- Low income respondents were more likely than non-low income respondents to indicate they would spend the money on household essentials, transportation, and paying down debt.
  - “We know that most of our low income clients have loans, past due balances on a lot of their accounts...I think that would be at the top of the list [of priorities if received stimulus check]. I don't know what would be after that... probably necessities, like foods that they can't get through SNAP or us all the time, grocery items.” (Charleston leader)
- Non-low income respondents were more likely than low income respondents to indicate they would spend the money on entertainment/non-essential spending, home and equipment upgrades and savings.
- Multifamily respondents were more likely than single family respondents to indicate they would spend the money on entertainment/non-essential spending and household essentials.
- Notably, non-low income and single family respondents were significantly more likely to indicate they would spend the money on home and equipment upgrades than low income respondents and multifamily respondents respectively.

Table 51. Theoretical future stimulus spending

	n	Entertainment /non-essential spending	Household essentials	Transportation	Home and equipment upgrades	Paying down debt (credit cards/loans /past due amounts)	Savings	Other
Overall	408	5%	53%	9%	16%	39%	9%	1%
<b>Income status</b>								
Non-low income (a)	283	6%	44%	7%	19% <sup>b</sup>	37%	11% <sup>b</sup>	1%
Low income (b)	125	3%	72% <sup>a</sup>	14% <sup>a</sup>	9%	44%	5%	0%
<b>Housing type</b>								
Single family (c)	306	4%	49%	9%	20% <sup>d</sup>	39%	9%	1%
Multifamily (d)	102	8% <sup>c</sup>	65% <sup>c</sup>	9%	3%	40%	9%	1%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Those respondents who indicated they would spend their future theoretical stimulus money on home and equipment upgrades were asked more specifically what types of home and equipment upgrades they would make with that money. Table 52 presents the percentage of respondents who indicated they would spend the money on a variety of home and equipment upgrades, broken down by customer segment.

- Overall, the type of home/equipment upgrade that most respondents indicated they would spend their future theoretical stimulus money on was cosmetic home upgrades (6%) followed by upgrade/replacement of windows/insulation/siding (5%), updates to heating and cooling equipment (4%), critical home repairs (3%), equipment upgrades (3%), solar panels and/or battery storage (1%), and other home and equipment upgrades (1%).
- Non-low income and single family respondents were more likely than their counterparts to indicate they would spend future theoretical stimulus money on all types of home and equipment upgrades.

Table 52. Theoretical future stimulus spending – home and equipment upgrades

	n	Updates to heating and cooling equipment	Cosmetic home upgrades	Critical home repairs	Equipment upgrades	Upgrade/replacement of windows, insulation, or siding	Solar panels and/or battery storage	Other
Overall	405	4%	6%	3%	3%	5%	1%	1%
<b>Income status</b>								
Non-low income (a)	281	5%	8% <sup>b</sup>	4%	4%	6%	2%	2%
Low income (b)	124	3%	3%	3%	1%	5%	0%	0%
<b>Housing type</b>								
Single family (c)	304	5% <sup>d</sup>	8% <sup>d</sup>	5%	4% <sup>d</sup>	7%	1%	2%
Multifamily (d)	101	1%	2%	0%	1%	0%	0%	0%

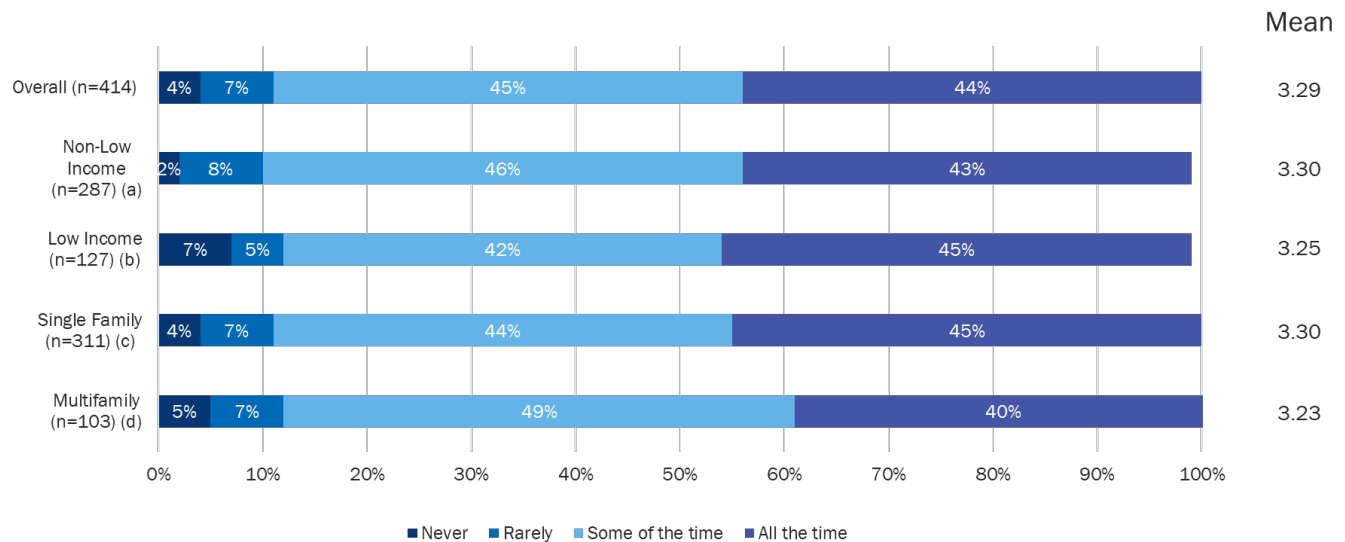
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how often, when purchasing energy using products, the amount of energy used by a product influenced their decision about which product to buy on a scale of 1 “never, to 5 “all the time.” Figure 6 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, most respondents indicated the amount of energy used by a product influenced their purchasing decision “some” or “all” of the time (89%).
- There were no significant differences in mean scores between customer segments, suggesting the influence of energy efficiency on decision-making was consistent regardless of income or housing type.
- Low income respondents were less likely than non-low income respondents to indicate that the amount of energy used by a product “never” influenced their purchasing decisions.
- Single family respondents were more likely than multifamily respondents to indicate that the amount of energy used by a product influenced their purchasing decision “all the time.”

Figure 6 . Influence of energy efficiency on purchasing decisions



Note: Results based on web survey data

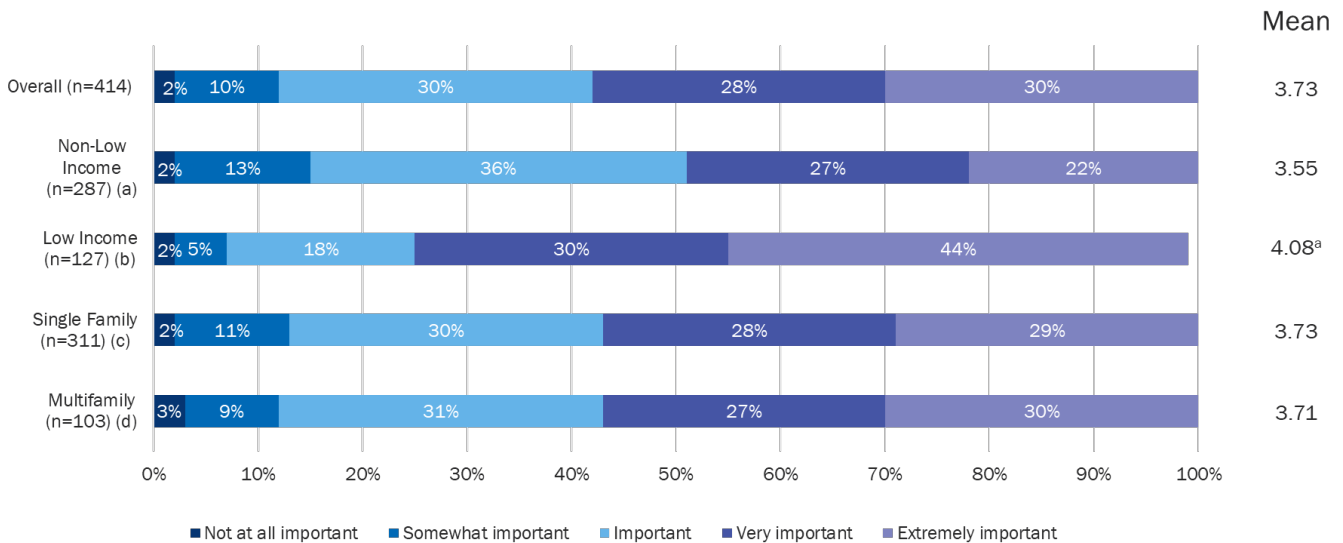
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 5.4 Energy Efficiency Perceptions and Considerations

The Study Team asked respondents how important saving electricity in their household was to them on a scale of 1 “not at all important” to 5 “extremely important.” Figure 7 presents the frequency of each response by percentage, broken down by customer segment.

- Overall, most respondents indicated that saving electricity in their household was at least “somewhat important” to them (98%). Over half of respondents (58%) indicated that saving electricity was “very” or “extremely important” to them.
- Non-low income customers are the majority of customers, 15% of which indicated saving electricity was “not at all important” or only “somewhat important to them”. Lack of concern towards saving electricity appears to have increased since the 2018 baseline study, with only about 2% of non-low income respondents indicating saving electricity was less than “important” to them at the time. A sizable customer base that lacks the desire or motivation to save electricity reflects an additional barrier to increasing participation in DESC program offerings.
- Low income respondents were more likely than non-low income respondents to indicate saving electricity in their household was “extremely important” to them.
- Low income respondents had a significantly higher mean score compared to non-low income respondents, suggesting that saving electricity at home was more important to them than non-low income respondents.

Figure 7. Importance of saving electricity



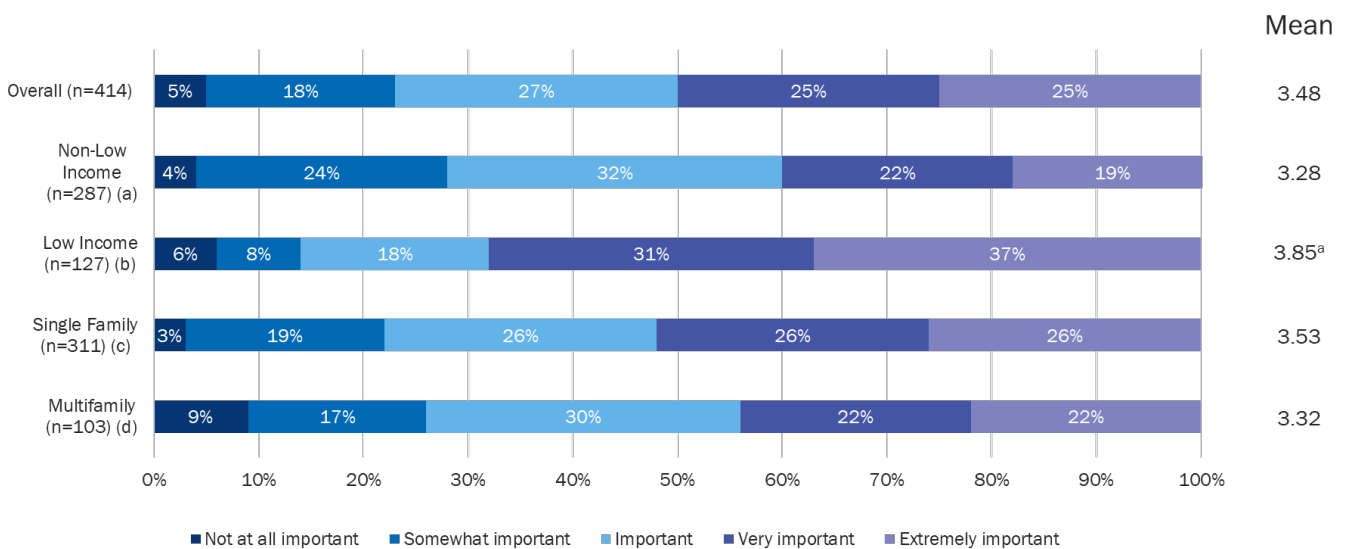
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how important saving electricity was to them when they purchase things that use electricity in their home was to them on a scale of 1 “not at all important” to 5 “extremely important.” Figure 8 presents the frequency of each response by percentage, broken down by customer segment.

- Overall, most respondents indicated saving electricity when they purchase things that use electricity in their home was at least “somewhat important” (95%). Over half of respondents (58%) indicated that saving electricity when purchasing things that use electricity was “very” or “extremely important” to them.
- Non-low income customers are the majority of customers, 28% of which indicated saving electricity when making purchases was “not at all important” or only “somewhat important” to them.
- Low income respondents were more likely than non-low income respondents to indicate that saving electricity when purchasing things that use electricity in the home was “extremely important” to them.
- The mean score for low income respondents was significantly higher than the mean score for non-low income respondents, suggesting that saving electricity when purchasing things that use electricity in the home was more important to low income respondents than it was to non-low income respondents.

Figure 8. Importance of saving electricity via purchases



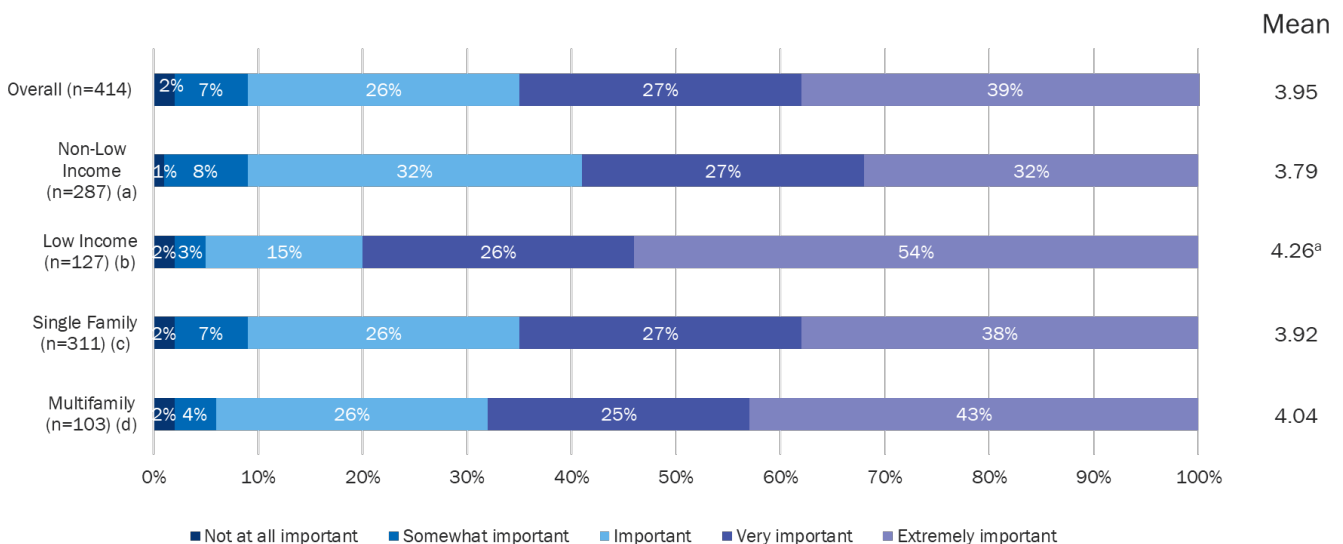
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how important saving money on their electric bill was to them on a scale of 1 “not at all important” to 5 “extremely important.” Figure 9 presents the frequency of each response by percentage, broken down by customer segment.

- Overall, most respondents indicated saving money on their electric bill was at least “somewhat important” to them (98%). Half of respondents indicated it was “very” or “extremely important” to them.
- Overall and amongst the largest customer segment (non-low income customers), 9% indicated that saving money on their energy bill was “not at all important” or only “somewhat important” to them. This population of customers may be particularly difficult to reach with energy efficiency program offerings, as the potential financial savings offered by the programs are not motivation enough to trigger interest.
- Low income respondents were more likely than non-low income respondents to indicate saving money on their electric bill was “extremely important” to them.
- The mean score for low income was significantly higher than the mean score for non-low income, suggesting that saving money on electric bills was significantly more important to low income respondents than it was to non-low income respondents.

Figure 9. Importance of saving money on energy bill



Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Respondents who indicated saving electricity was less than “extremely important” in their household were asked why they felt that way. Table 53 presents the percentage of respondents who indicated each reason, broken down by customer segment.

- Overall, the biggest reason respondents felt saving electricity in their home was less than “extremely important” was because being comfortable was more important to them than saving energy (33%), followed by the home being newer and already energy-efficient (23%), the electric bill not being high enough that there was a need to make changes in the household (19%), saving electricity in the

household seeming too small to make a difference (17%), not being able to control the actions of others in the household (15%), not being aware of actions that can be taken to save electricity (15%), other home upgrades being more important (8%), and other reasons (8%).

- The prioritization of comfort over energy savings is a major barrier to reaching customers with DESC's programs offerings. Although difficult to overcome, DESC may be able to mitigate customers' concerns by providing additional education on how to balance comfort and energy savings through program participation and behavioral changes.
- Nearly a third of low income respondents indicated they thought saving electricity made too small a difference for it to be "extremely important". From the perspective of a low income respondent this sentiment is somewhat true, as customers can typically only save 10% to 25% on their bill by participating in energy efficiency programs, with the exception of programs involving new equipment or major renovations. This suggests that steps need to be taken to make energy savings more attractive to low income customers beyond the potential, relatively small, financial savings. Potential avenues for this could be to increase education on the environmental benefits and to make the participation process low effort for the customer.
- Non-low income respondents were more likely than low income respondents to indicate saving electricity was less than "extremely important" because the electric bill was not high enough that there was a need to make changes or the home was newer and already energy-efficient. Low income respondents were more likely than non-low income respondents to indicate all other potential responses.
- Multifamily respondents were more likely than single family respondents to indicate saving electricity was less than "extremely important" because the electric bill was not high enough that there was a need to make changes. Single family respondents were more likely than multifamily respondents to indicate all other potential responses.

Table 53. Why saving electricity is not "extremely important"

	n	Electric bill is not high enough that there is a need to make changes	Saving electricity seems too small to make a difference	Cannot control the actions of others	Not aware of actions that can be taken to save electricity	Being comfortable is more important than saving energy	Other home upgrades are more important	Home is newer and already energy efficient	Other reasons
Overall	175	19%	17%	15%	15%	33%	8%	23%	8%
<b>Income status</b>									
Non-low income (a)	143	22% <sup>b</sup>	13%	13%	15%	32%	7%	25%	7%
Low income (b)	32	9%	30% <sup>a</sup>	22%	17%	39%	11%	13%	11%
<b>Housing type</b>									
Single family (c)	136	16%	17%	18% <sup>d</sup>	16%	34%	11%	26% <sup>d</sup>	8%
Multifamily (d)	39	31% <sup>c</sup>	15%	3%	14%	31%	0%	13%	9%

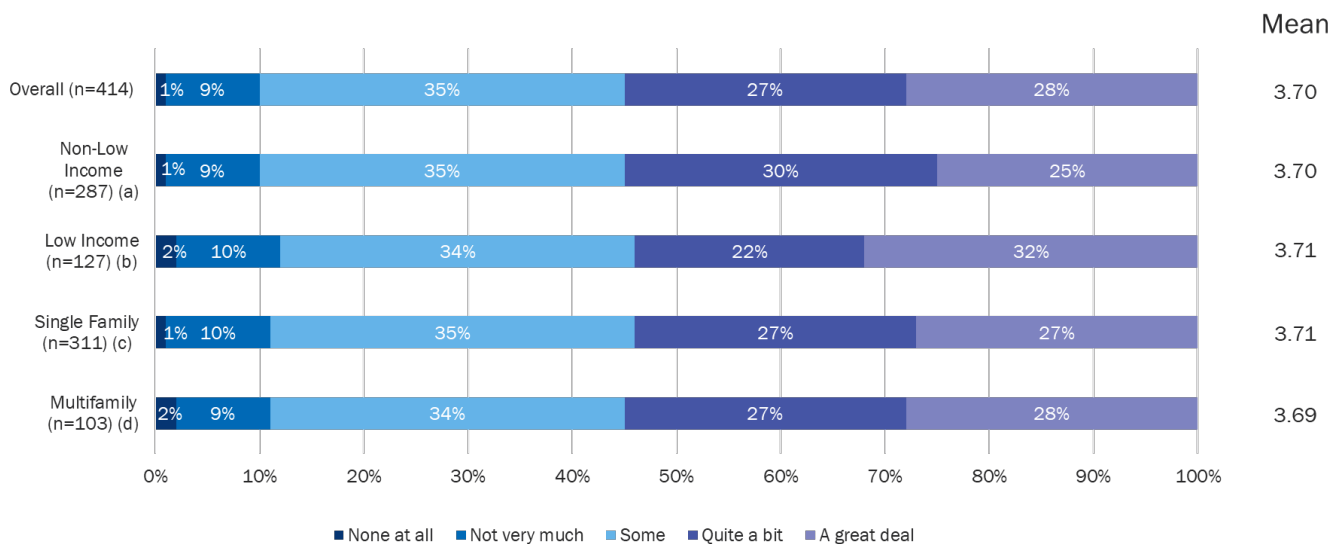
Note: Results based on web survey data; respondents who indicated that saving electricity was less than "extremely important"

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how much control they felt they had over the amount of electricity their household used. Figure 10 presents the frequency of each response by percentage, broken down by customer segment.

- Overall, most respondents indicated they felt they had at least “some” control over how much electricity their household used (90%). Over half of respondents (54%) indicated they felt they had “quite a bit” or “a great deal” of control of their household electricity usage.
- There were no significant differences in mean scores between customer segments, suggesting that sense of control over electricity use was consistent regardless of income or housing type.

Figure 10. Sense of control over electricity usage



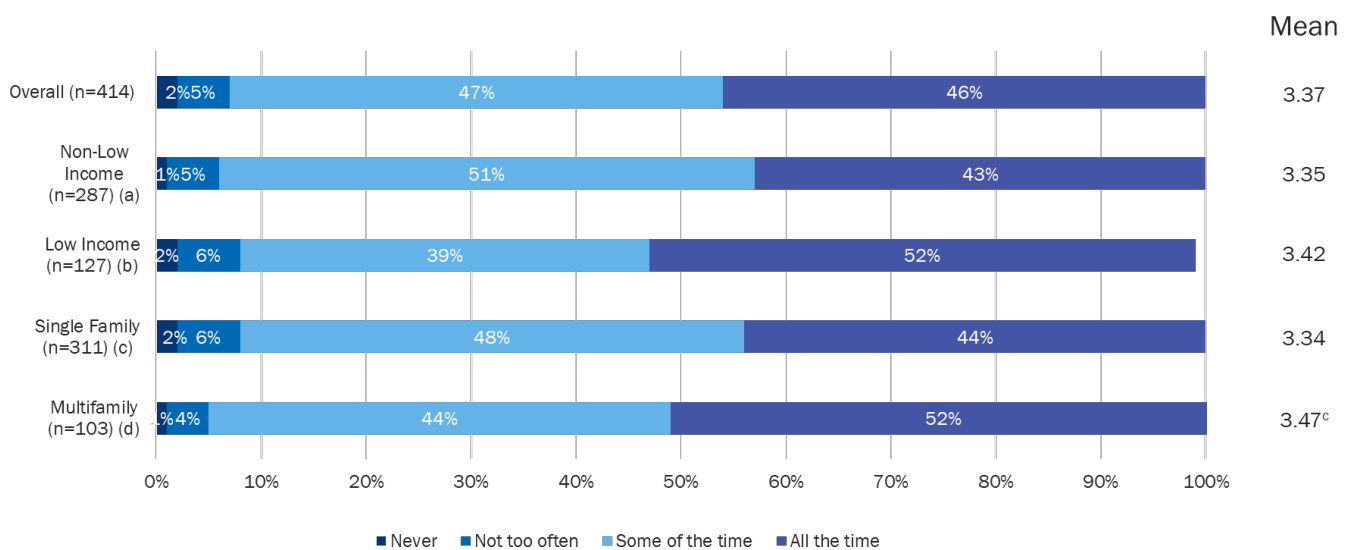
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents how often they made an effort to live in ways that reduced their home's electric usage. Figure 11 presents the frequency of each response by percentage, broken down by customer segment.

- Overall, most respondents indicated they made an effort to live in ways that reduced their electricity usage at least “some of the time” (93%). Slightly less than half of respondents (46%) indicated they made an effort to live in ways that reduced their electricity usage “all the time.”
- Low income and multifamily respondents were more likely than their counterparts to indicate they made an effort to live in ways that reduced their electricity “all the time.”
- The mean score for multifamily respondents was significantly higher than the mean score for single family respondents, suggesting multifamily respondents made an effort to live in ways that reduced their electricity usage more than single family respondents.

Figure 11. Effort to live in ways that reduce electricity usage



Note: Results based on web survey data a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents what actions, other than major home upgrades, they had taken to save energy in their home in the last year. Table 54 presents the percentage of respondents who indicated taking each action, broken down by customer segment.

- Overall, the action most respondents indicated taking in the past year was turning off lights when not in use (87%), followed by lowering the thermostat (67%), checking the air filters monthly (61%), switching to LEDs (56%), and turning off or unplugging appliances (55%). Less respondents indicated having the heating and air systems checked regularly (36%), setting water heaters to 120 degrees Fahrenheit (23%), caulking/sealing/weather-stripping around all seams/cracks/openings (23%), and sealing ductwork (11%). Few respondents reported upgrading insulation (6%), or other energy saving actions (2%).
- Non-low income respondents were more likely than low income respondents to indicate doing all energy saving actions, with the exception of turning off or unplugging appliances. More specifically, there is an area of opportunity for education around other energy saving actions among low income such as thermostat temperature setting.
- Single family respondents were more likely than multifamily respondents to indicate doing all energy saving actions, with the exception of “other” energy saving actions.

Table 54. Energy saving actions past year

	n	Turned off lights when not in use	Switched to LEDs	Lowered the thermostat temperature in the winter and increased it in the summer to reduce heating and cooling load	Turned off or unplugged appliances when not in use	Sealed ductwork	Caulked, sealed, and weather-stripped around all seams, cracks, and openings	Checked air filters monthly	Had heating and air systems checked regularly	Periodically checked the ductwork for leaks or tears	Upgraded your attic insulation to a minimum of R-38 (12-14 inches)	Set your water heater at 120 ° F	Other
Overall	414	87%	56%	67%	55%	11%	23%	61%	36%	14%	6%	23%	2%
Income status													
Non-low Income (a)	287	92% <sup>b</sup>	62% <sup>b</sup>	74% <sup>b</sup>	51%	12%	24%	67% <sup>b</sup>	42% <sup>b</sup>	17% <sup>b</sup>	7%	25%	3%
Low income (b)	127	79%	42%	53%	63% <sup>a</sup>	9%	19%	48%	23%	9%	4%	18%	1%
Housing type													
Single family (c)	311	88%	59% <sup>d</sup>	69% <sup>d</sup>	58% <sup>d</sup>	14% <sup>d</sup>	28% <sup>d</sup>	64% <sup>d</sup>	42% <sup>d</sup>	17% <sup>d</sup>	8% <sup>d</sup>	28% <sup>d</sup>	2%
Multifamily (d)	103	85%	46%	60%	44%	3%	5%	53%	16%	5%	1%	5%	3%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 6. Energy Costs, Energy Burden, and Economic Hardship

### 6.1 Energy Burden

One of the measures of hardship a customer may experience is energy burden. The standard, basic calculation of “customer energy burden” is the sum of each customer’s household energy bills during a given year divided by their household income for that year, notated as:

#### Equation 2 Energy Burden

$$\text{Dominion Energy Customer Energy Burden} = \text{Annual Dominion Energy Bill Amounts} / \text{Annual Income}$$

To calculate Dominion Energy customers’ energy burden, the team needed these two pieces of additional information, energy costs and annual income. Then, the team could also create a weighted average of individual customer energy burden results to represent the overall average energy burden metric.

To calculate the 2020 energy costs of surveyed customers, the team requested and received from billing data for each customer who completed the survey. This billing data included electric and natural gas costs but did not include any alternative fuel costs. The Study Team summed the monthly bill amounts to calculate the annual bill amount for each customer. When the full 12 months was not available, the team attempted to impute from the 2021 data for multiple missing months or if only one month was missing, the team took the average of the month immediately before and after. After these attempts, the team excluded anyone who had less than 11 months. For those who had only 11 months, the team annualized the amount.

To estimate annual household income for energy burden calculations, the team took the midpoint of the household income range customers selected in the survey (e.g., \$8,000 to less than \$16,000 = \$12,000 midpoint). For the highest income category that respondents could select (above \$200,000), the team used a value of \$200,001. The Study Team did not estimate energy burden for customers that refused to provide their household income in the survey, were missing energy cost data, were on master-metered accounts, or had negative energy costs due to net metering.<sup>6</sup>

### 6.2 Economic Hardship

The Study Team also constructed a measurement of “lived economic hardship” as energy costs and energy burden alone fail to demonstrate the lived experience associated with high energy bills. To enable measurement of economic hardship, the survey included questions from previously validated metrics of financial health: the Consumer Financial Protection Bureau’s (CFPB) Financial Well-Being Scale.<sup>7</sup> The first question in this battery asks how each item describes the respondent’s situation, using a five-point scale from 1 “not at all” to 5 “completely”. The three items include:

- Because of my financial situation, I feel like I will never have the things I want in life.
- I am just getting by financially.

<sup>6</sup> Energy burden calculations exclude 276 households that had energy costs but did not provide income, 832 households that were missing energy cost data, 28 accounts that were master-metered and 10 accounts with negative total electricity costs. Only one of the 10 accounts with negative electricity costs resulted in negative total energy costs. Given the small number of accounts with negative electricity costs, study conclusions are not impacted by excluding respondents with negative costs.

<sup>7</sup> The Researchers used The CFPB’s methods for the abbreviated version of their “Financial Well-Being Scale.” See this link for further details on the methodology: [https://files.consumerfinance.gov/f/201512\\_cfpb\\_financial-well-being-user-guide-scale.pdf](https://files.consumerfinance.gov/f/201512_cfpb_financial-well-being-user-guide-scale.pdf)

- I am concerned that the money I have won't last.

The second set of questions in this battery asks how often each item applies to the respondent, using a five-point scale from 1 “never” to 5 “always”. The two items include:

- I have money left over at the end of the month.
- My finances control my life.

The Study Team calculated the CFPB index using the five items and the respondent's age, as instructed by the CFPB.<sup>8</sup> Scores range from 19 to 90, where lower scores correspond to higher levels of economic hardship. To ease interpretation and for consistency with prior use of the metric in California studies, the team inversed the scale and normalized the values to a 0 to 10 scale, where higher values demonstrate greater levels of economic hardship.

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<sup>8</sup> The CFPB provides two scoring charts, depending on age group: one for respondents with ages between 18 to 61, and another for respondents that are at least 62 years old. The scoring chart for older respondents gives comparatively less weight to their responses, as the CFPB found that responses from older respondents skewed towards greater economic hardship thanks to their “shift from working and accumulating savings to exiting the workforce and decumulating savings.” CFPB asserts that by taking age-oriented differences into account, the scale is in turn normalized and is thus directly comparable across all age groups.

## 6.3 Results of Energy Burden and Economic Hardship

Table 55 contains the average 2020 energy costs, energy burden, and economic hardship index broken down by customer segment.

- Overall, households spent 6.5% of 2020 household income on home energy costs.
- Low income households had a significantly higher energy burden and economic hardship index than non-low income households (12.0% vs. 3.9% and 6.2 vs. 4.5 respectively).
- Single family households spent more on energy costs in 2020 than multifamily households. However, they did not differ significantly on energy burden or economic hardship.
- South Carolina residents living at or below 200% FPL have an energy burden of 10%, compared to a state average of 3%. Our research indicates that low-income DESC customers have a slightly higher energy burden (12%) than the state average for that segment.

Table 55. Energy burden and economic hardship

	n	Total costs*	Energy burden†	Economic hardship
Overall	294-355	\$2,840	6.5%	5.07
<b>Income status</b>				
Non-low income (a)	207-288	\$2,843	3.9%	4.52
Low income (b)	87-108	\$2,833	12.0% <sup>a</sup>	6.22 <sup>a</sup>
<b>Housing type</b>				
Single family (c)	230-280	\$3,063 <sup>d</sup>	6.8%	4.97
Multifamily (d)	64-82	\$1,984	5.4%	5.37

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

\*Households annual energy bills over \$8,500 were spot checked to ensure they aligned with the associated housing type and square footage. Six of seven households with annual energy bills over \$8,500 were excluded from analysis of total costs due to the costs being inconsistent with household type and size.

†In addition to the six households excluded from the analysis of total energy costs, 8 additional households with an energy burden over 30% were excluded from the analysis of energy burden. This exclusion criteria were defined to reflect the upper limit of the average national energy burden, as noted by the United States Census Bureau.<sup>9</sup>

<sup>9</sup> US Census Bureau. Accessed 03/28/21. "U.S. Department of Energy Uses ACS Data to Power the Low-Income Energy Affordability Data (LEAD) Tool." <https://www.census.gov/programs-surveys/acs/about/acs-data-stories/lead-tool.html#:~:text=Based%20on%20ACS%20and%20LEAD,non%2Dlow%2Dincome%20households>

## 7. Health/Comfort/Safety

### 7.1 Health Hardship

The Study Team constructed a measurement of “health hardship” that operationalizes household health into a quantitative value ranging from 0 (no health hardship) to 10 (high health hardship). It is comprised of two survey questions the team developed from the Centers for Disease Control and Prevention’s Behavioral Risk Factor Surveillance System (BRFSS), as follows:

**Frequency of poor health:** The Study Team asked respondents how often their health and the health of members of their household was not good during the past year, using a five-point scale from 1 “never” to 5 “most or all the time”.

**Frequency poor health limited usual activities:** The Study Team asked respondents who indicated that they and/or members of their household experienced poor health more than never during the past year how often the poor health prevented them from doing their usual activities. The Study Team used the same five-point scale from 1 “never” to 5 “most of all the time”.

These results were summed (resulting in a range of 2 to 10), which was normalized to a 0 to 10 scale so that interpretation of the health hardship metric was similar to that of the economic hardship metric. To assess reliability of the items in the model, the team calculated Cronbach’s alpha. The resulting Cronbach’s alpha of 0.89 reveals good internal consistency between the items included in the health hardship metric.

Table 56 includes the results of our Health Hardship analysis.

Overall, households had an average health hardship index of 3.3, revealing that most households tend to have low to moderately low health hardship.

Low income customers have significantly higher average health hardship scores compared to non-low income customers, indicating that they and/or members of their household were more likely to not have good health during the last year which also impacted their usual activities.

Table 56. Health hardship

	n	Health hardship
Overall	373	3.3
<b>Income status</b>		
Non-low Income (a)	256	3.1
Low Income (b)	117	3.8 <sup>a</sup>
<b>Housing type</b>		
Single family (c)	281	3.4
Multifamily (d)	92	3.3

Note: Results based on web survey data

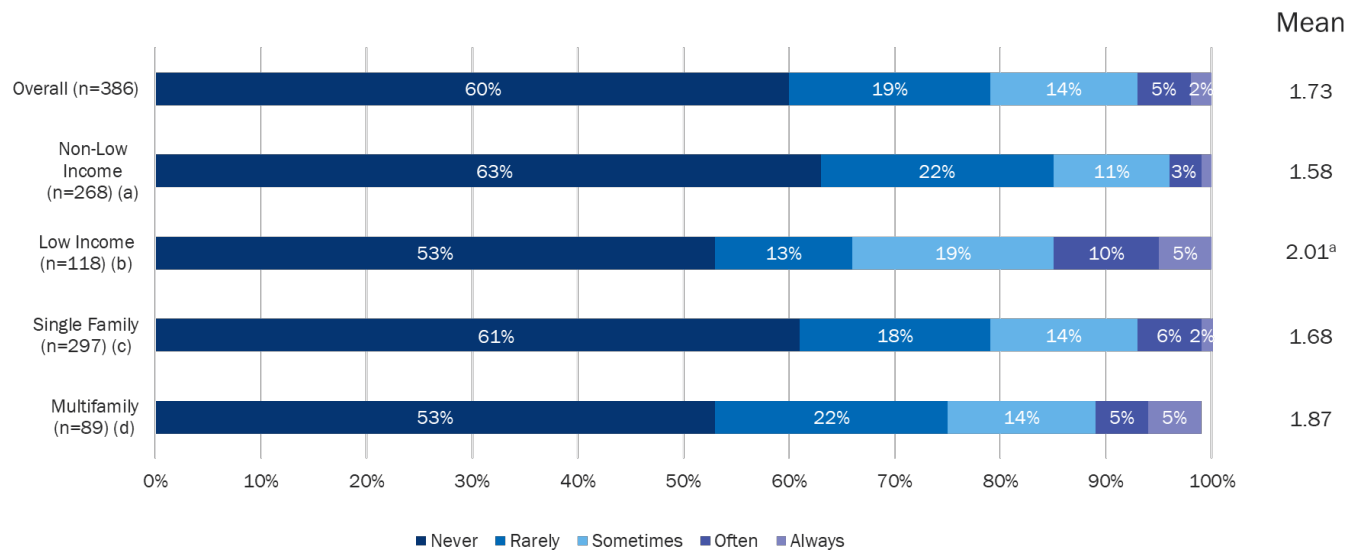
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 7.2 Other Health Issues

The survey asked respondents how often they experienced mold, mildew, fungus, or moisture in their homes on a 5-point scale (Figure 12). Mold can cause respiratory issues and exacerbate asthma and thus can create health issues.

- Overall, 7% of respondents experienced mold, mildew, fungus, or moisture often or always in their homes. Respondents more frequently reported experiencing it “sometimes” (14%) or “rarely” (19%).
- Low income households had a significantly higher mean score than non-low income customers, suggesting that low income households were more likely than non-low income households to experience mold, mildew, fungus, or moisture in the home.
- 15% of low income respondents reported experiencing mold, milder, fungus, or moisture in the home “often” or “always” compared to their non-low income counterparts (4%).

Figure 12. Presence of mold, mildew, fungus, or moisture in the home



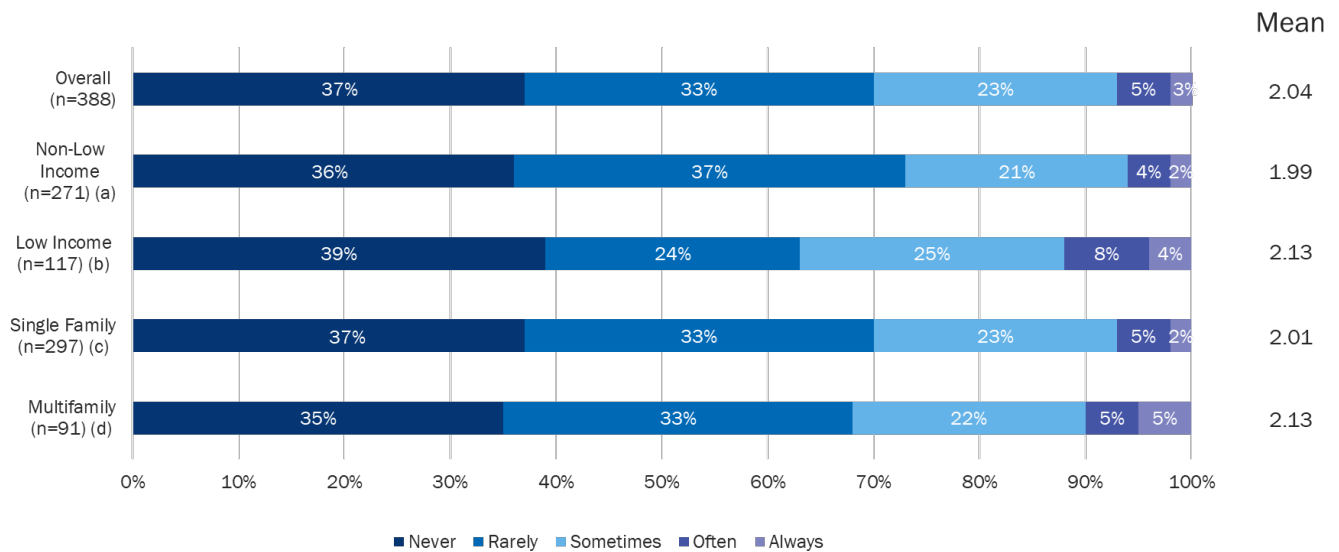
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The survey asked respondents how often they had pests such as rodents, insects, or spiders in their homes on a 5-point scale (Figure 13). The presence of pests in the home presents a potential health issue that DESC could aim to address, if desired. This data also speaks to the condition of the home in combination with the other questions about mold and drafts.

- Overall, 8% of residents had pests such as rodents, insects, or spiders in their homes “often” or “always”. Respondents more frequently reported having pests “sometimes” (23%) or “rarely” (33%).
- The findings show little difference in the incidence of pests by income category or housing type.

Figure 13. Presence of pests such as rodents, insects, or spiders in the home



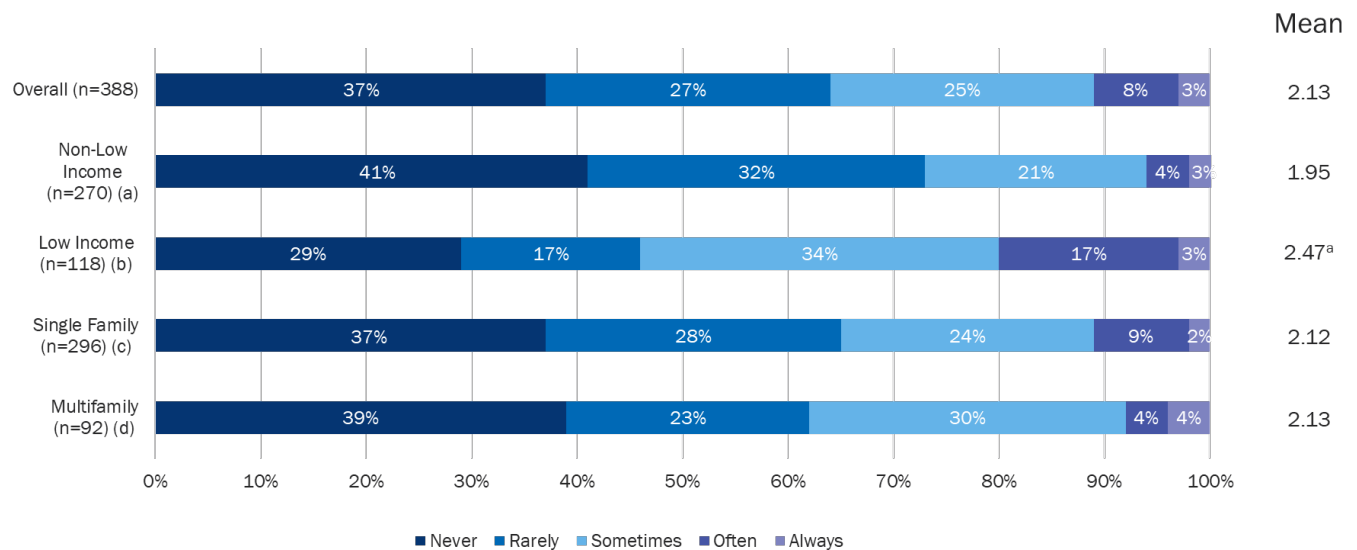
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The survey asked respondents how often they experienced uncomfortably cool temperatures on cold days or nights in their homes (Figure 14).

- Overall, 11% of residents experienced uncomfortably cool temperatures on colds day or nights in their homes “often” or “always”. Respondents more frequently reported experiencing uncomfortable cool temperatures “sometimes” (25%) or “rarely” (27%).
- Low income households had a significantly higher mean score than non-low income customers, suggesting that low income households were more likely than non-low income households to experience uncomfortable cool temperatures in their homes.
- 20% of low income respondents reported experiencing uncomfortably cool temperatures in the home “often” or “always” compared to their non-low income counterparts (7%).

Figure 14. Frequency of uncomfortably cool temperatures



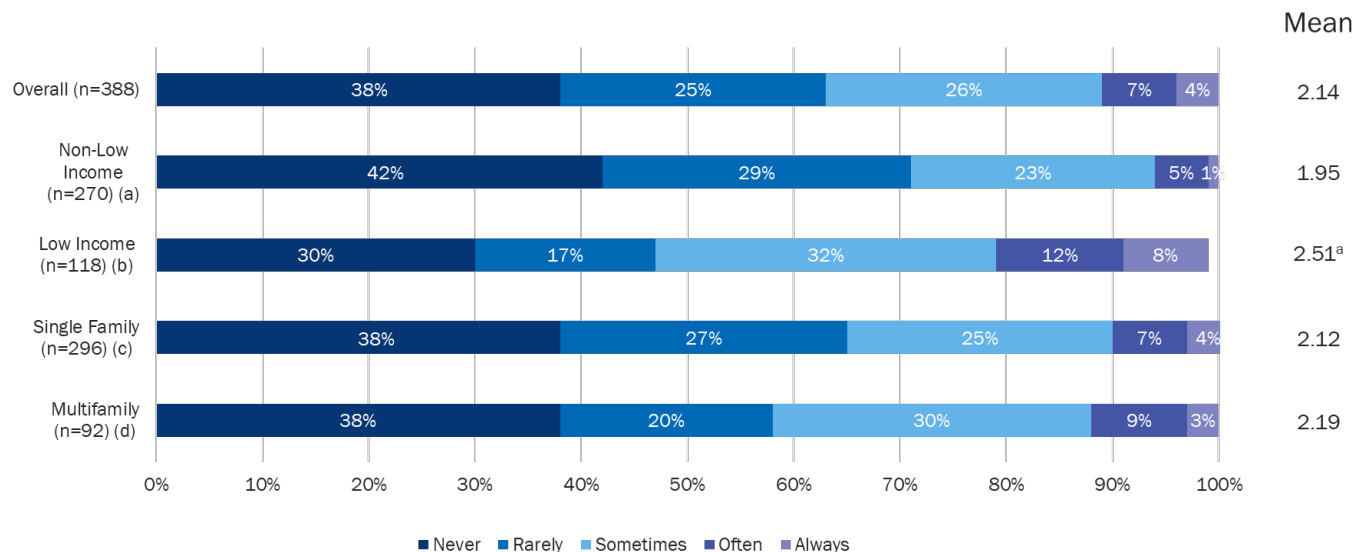
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The survey asked respondents how often they experienced uncomfortably warm temperatures on hot days or nights in their homes on a five-point scale (Figure 15).

- Overall, 11% of residents experienced uncomfortably warm temperatures on hot day or nights in their homes “often” or “always”. Most respondents experienced uncomfortable warm temperatures “sometimes” (26%), “rarely” (25%) with the majority reporting “never” (37%). Most respondents indicated never having experienced uncomfortably warm temperatures both overall and across subgroups. This suggests that residents may lack the motivation to participate in certain programs as they are never or are infrequently experiencing issues with the temperature of their homes.
- Low income households had a significantly higher mean score than non-low income customers, suggesting that low income households were more likely than non-low income households to experience uncomfortable warm temperatures in their homes.
- 20% of low income respondents reported experiencing uncomfortably warm temperatures in the home “often” or “always” compared to their non-low income counterparts (6%).

Figure 15. Frequency of uncomfortably warm temperatures



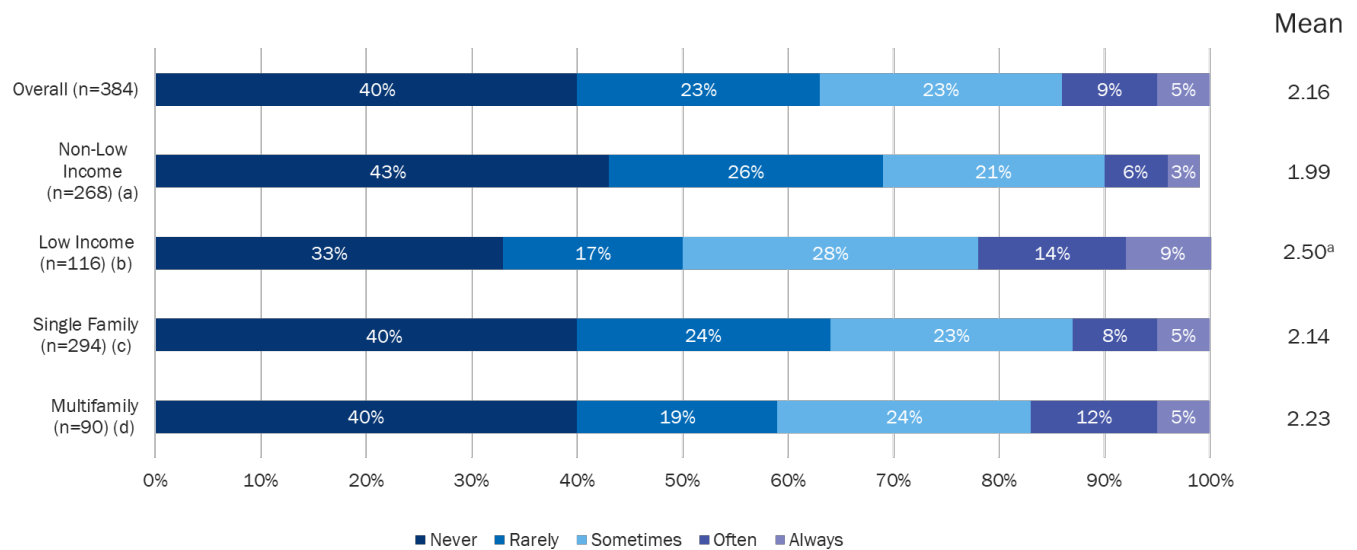
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The survey asked respondents how often they experienced drafts coming from outside in their homes on a five-point scale (Figure 16).

- Overall, 14% of residents experienced drafts coming in from outside in their home “always” or “often”. Most experienced it “sometimes” (23%) or “rarely” (23%). This suggests that residents may lack the motivation to participate in certain programs as they are never or are infrequently experiencing issues with drafts in their homes.
- Low income households had a significantly higher mean score than non-low income customers, suggesting that low income households were more likely than non-low income households to experience drafts coming in from outside in the home.
- 23% of low income respondents reported experiencing drafts “often” or “always” compared to their non-low income counterparts (9%).

Figure 16. Frequency of drafts from outside



Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8. Key Penetration Results

### 8.1 Space Heating

Table 57 presents results on the penetration of different types of space heating in DESC homes.

- All homes have space heating, with the most prevalent types of space heating being air source heat pumps (53%), (usable) fireplaces (39%), portable space heaters (31%), and central forced air furnaces (27%). A smaller portion of homes had gas packs (12%) and other space heating equipment (11%); a few homes had electric baseboards (1%), wood/wood pellet stoves (1%), or ductless heat pumps (<1%). No homes had hot water/steam boilers or geothermal heat pumps.
- Non-low income and single family residents are more likely than their counterparts to have an air source heat pump.
- Non-low income residents are more likely than low income residents to have a fireplace.
- Low income and single family residents are more likely than their counterparts to have a portable space heater or gas pack.
- Low income and multifamily residents are more likely than their counterparts to have a central forced air furnace.
- Non-low income and multifamily residents are more likely than their counterparts to have an “other” type of space heating equipment.

Table 57. Space heating penetration

	n	Air source heat pump	Fireplace	Usable fireplace	Portable space heater	Central forced air furnace	Gas pack	Other heating equipment	Electric baseboard	Wood/wood pellet stove	Ductless heat pump	Hot water/steam boiler	Geothermal heat pump
Overall	169	53%	48%	39%	31%	27%	12%	11%	1%	1%	<1%	0%	0%
<b>Income status</b>													
Non-low income (a)	81	56% <sup>b</sup>	52% <sup>b</sup>	44% <sup>b</sup>	29%	26%	10%	12%	2%	1%	0%	0%	0%
Low income (b)	88	41%	28%	21%	39% <sup>a</sup>	29%	20% <sup>a</sup>	7%	0%	3%	1%	0%	0%
<b>Housing type</b>													
Single family (c)	110	54%	48%	39%	35% <sup>d</sup>	26%	12%	10%	2%	<1%	<1%	0%	0%
Multifamily (d)	59	49%	47%	39%	16%	30%	9%	13%	0%	4% <sup>c</sup>	0%	0%	0%

Note: Results based on on-site data a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

### 8.1.1 Primary Space Heating

Table 58 presents results on the penetration of different types of primary space heating in DESC homes.

- The most prevalent sources of primary heating in homes are air source heat pumps (48%) and central forced air furnaces (21%). A smaller portion of homes have gas packs (11%), other space heating equipment (13%), or portable space heaters (5%) as their primary heating. Few homes have electric baseboards (1%), fireplaces (<1%), or wood/wood pellet stoves (<1%) as their primary heating. No homes have ductless heat pumps, hot water/steam boilers, or geothermal heat pumps as their primary heating.
- Non-low income residents are more likely than low income residents to have an air source heat pump as their primary source of space heating.
- Low income and multifamily residents are more likely than their counterparts to have a central forced air furnace as their primary source of space heating.
- Low income and single family residents are more likely than their counterparts to have a gas pack or portable space heater as their primary source of space heating.
- Non-low income residents are more likely than low income residents to have an “other” type of space heating or electric baseboard as their primary source of space heating.

Table 58. Primary space heating penetration

	n	Air source heat pump primary heating	Central forced air furnace primary heating	Other heating equipment primary heating	Gas pack primary heating	Portable space heater primary heating	Electric baseboard primary heating	Fireplace primary heating	Wood/wood pellet stove primary heating	Ductless heat pump primary heating	Hot water/steam boiler primary heating	Geothermal heat pump primary heating
Overall	169	48%	21%	13%	11%	5%	1%	<1%	<1%	0%	0%	0%
Income status												
Non-low income (a)	81	51% <sup>b</sup>	20%	15% <sup>b</sup>	10%	3%	2%	0%	0%	0%	0%	0%
Low income (b)	88	37%	25%	5%	17% <sup>a</sup>	14% <sup>a</sup>	0%	1%	1%	0%	0%	0%
Housing type												
Single family (c)	110	48%	19%	13%	12%	7% <sup>d</sup>	2%	<1%	0%	0%	0%	0%
Multifamily (d)	59	48%	28% <sup>c</sup>	13%	9%	2%	0%	0%	1%	0%	0%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.2 Cooling Systems

Table 59 presents results on the penetration of different types of major cooling systems in DESC homes.

- All homes have cooling equipment and most have central air conditioning (90%). The most prevalent type of cooling equipment being air source heat pumps (53%). Few homes have a ductless heat pump (<1%) and no homes have a geothermal heat pump.
- Non-low income and multifamily residents are more likely than their counterparts to have a central air conditioner.
- Non-low income and single family residents are more likely than their counterparts to have an air source heat pump.
- Low income residents are less likely to have central air conditioning than any other customer segment.

Table 59. Major cooling systems penetration

	n	Central air conditioner	Air source heat pump	Ductless heat pump	Geothermal heat pump
Overall	168	90%	53%	<1%	0%
<b>Income status</b>					
Non-low income (a)	81	92% <sup>b</sup>	56% <sup>b</sup>	0%	0%
Low income (b)	87	82%	41%	1%	0%
<b>Housing type</b>					
Single family (c)	109	89%	54%	<1%	0%
Multifamily (d)	59	94%	49%	0%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Table 60 presents results on the penetration of alternate types of cooling systems in DESC homes.

- Approximately a quarter of homes have a portable fan (29%) or portable air conditioner (22%). Less than 1% of homes have a different type of cooling equipment than those included under “major” or “alternate” cooling systems.
- Low income and single family residents are more likely than their counterparts to have a portable fan or portable air conditioner.

Table 60. Alternate cooling systems penetration

	n	Portable fan	Portable air conditioner	Other cooling equipment
Overall	168	29%	22%	<1%
<b>Income status</b>				
Non-low income (a)	81	29%	21%	0%
Low income (b)	87	33%	28%	1%
<b>Housing type</b>				
Single family (c)	109	32% <sup>d</sup>	23%	<1%
Multifamily (d)	59	22%	19%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.2.1 Primary Cooling Systems

Table 61 presents results on the penetration of different types of primary cooling systems in DESC homes.

- The most prevalent sources of primary cooling homes are central air conditioners (54%) and air source heat pumps (36%). Few homes have portable air conditioners (10%) or portable fans (1%) as their primary cooling. No homes have ductless heat pumps or geothermal heat pumps as their primary cooling.
- Non-low income residents are more likely than low income residents to have a central air conditioner as their primary cooling.
- Low income residents are more likely than non-low income residents to have portable fans or portable air conditioners as their primary cooling.
- Multifamily residents are more likely than single family residents to have an air source heat pump or portable fan as their primary cooling.

Table 61. Primary cooling system penetration

	n	Central air conditioner primary cooling	Air source heat pump primary cooling	Portable fan primary cooling	Portable air conditioner primary cooling	Other cooling equipment primary cooling	Ductless heat pump primary cooling	Geothermal heat pump primary cooling
Overall	168	54%	36%	1%	10%	<1%	0%	0%
<b>Income status</b>								
Non-low income (a)	81	55%	37%	0%	8%	0%	0%	0%
Low income (b)	87	47%	31%	3% <sup>a</sup>	17% <sup>a</sup>	1%	0%	0%
<b>Housing type</b>								
Single family (c)	109	54%	34%	<1%	11%	<1%	0%	0%
Multifamily (d)	59	54%	39%	2%	6%	0%	0%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.3 Thermostats

Table 62 presents results on the penetration of different types of thermostats in DESC homes.

- Most homes have a thermostat (94%), with most having a manual thermostat (67%). Around a quarter of homes have a programmable thermostat (24%) and few households have a smart thermostat (6%).
- Non-low income residents are more likely than low income residents to have a thermostat.
- Low income and multifamily residents are more likely than their counterparts to have a manual thermostat.
- Non-low income and single family residents are more likely than their counterparts to have a programmable or smart thermostat.

Table 62. Thermostat penetration

	n	Thermostat	Manual	Programmable	Smart	No thermostat
Overall	170	94%	67%	24%	6%	6%
Income status						
Non-low income (a)	81	96% <sup>b</sup>	64%	29% <sup>b</sup>	6%	4%
Low income (b)	89	88%	80% <sup>a</sup>	5%	5%	12% <sup>a</sup>
Housing type						
Single family (c)	110	94%	63%	27% <sup>d</sup>	6%	6%
Multifamily (d)	60	97%	79% <sup>c</sup>	17%	5%	3%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.4 Water Heating

Table 63 presents results on the penetration of different types of water heaters in DESC homes.

- All homes have a water heater, with most homes having a storage (tank) water heater (88%). A small portion of homes have an on-demand (tankless) water heater (12%), and no homes have a heat pump water heater, boiler, or other type of water heater.
- Low income and multifamily residents are more likely than their counterparts to have a storage (tank) water heater.
- Non-low income and single family residents are more likely than their counterparts to have an on-demand (tankless) water heater.

Table 63. Water heating penetration

	n	Water heater	Storage (tank)	On-demand (tankless)	Heat pump	Boiler
Overall	170	100%	88%	12%	0%	0%
<b>Income status</b>						
Non-low income (a)	81	100%	86%	14% <sup>b</sup>	0%	0%
Low income (b)	89	100%	94% <sup>a</sup>	6%	0%	0%
<b>Housing type</b>						
Single family (c)	110	100%	86%	14%	0%	0%
Multifamily (d)	60	100%	93%	7%	0%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.5 Cooking

Table 64 presents results on the penetration of different types of cooking equipment in DESC homes.

- All homes have cooking equipment with the most prevalent types of cooking equipment being microwaves (90%) and ranges (89%).
- Low income residents are more likely than non-low income resident to have a range or microwave. Non-low income residents are more likely than low income residents to have a stove top or wall oven.
- Single family residents are more likely than multifamily residents to have a microwave, stove top, or wall oven. Multifamily residents are more likely than single family residents to have a range or grill.

Table 64. Cooking equipment penetration

	n	Microwave	Range	Stove top	Wall oven	Other cooking equipment	Grill/BBQ	Camping /portable stove top	Wood-burning cookstove
Overall	155	90%	89%	11%	8%	7%	1%	<1%	<1%
<b>Income status</b>									
Non-low income (a)	71	88%	88%	12%	9% <sup>b</sup>	7%	1%	0%	0%
Low income (b)	84	94% <sup>a</sup>	94%	6%	4%	5%	0%	1%	1%
<b>Housing type</b>									
Single family (c)	98	91%	88%	12%	9%	7%	0%	<1%	0%
Multifamily (d)	57	86%	93%	7%	5%	6%	2% <sup>c</sup>	0%	1%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.6 Building Envelope – Basement/Crawlspace

Table 65 presents results on the penetration of basements, crawlspaces, and the associated insulation in DESC homes.

- Few homes have a basement (1%) and none have a basement with insulation. Over half of homes have a crawlspace (57%), however only 32% of homes have some form of insulation in the crawlspace.
- Low income residents are more likely than non-low income residents to have a crawlspace, however, non-low income residents are more likely than low income residents to have an insulated crawlspace.
- Single family residents are more likely than multifamily residents to have a crawlspace/crawlspace with insulation.

Table 65. Basement/crawlspace penetration

	n	Crawlspace	Crawlspace insulation	Basement	Basement insulation	No basement/crawlspace
Overall	170	57%	32%	1%	0%	41%
<b>Income status</b>						
Non-low income (a)	81	56%	35% <sup>b</sup>	1%	0%	42%
Low income (b)	89	61%	18%	0%	0%	39%
<b>Housing type</b>						
Single family (c)	110	65% <sup>d</sup>	37% <sup>d</sup>	0%	0%	35%
Multifamily (d)	60	34%	15%	5% <sup>c</sup>	0%	62% <sup>c</sup>

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.7 Building Envelope – Attic

Table 66 presents results on the penetration of attics and the associated insulation in DESC homes.

- Most homes have an attic (62%). Approximately half of homes have an attic with insulation (52%).
- Non-low income and single family residents are more likely than their counterparts to have an attic/an attic with insulation.

Table 66. Attic penetration

	n	Attic	Attic insulation
Overall	170	62%	52%
<b>Income status</b>			
Non-low income (a)	81	64%	56% <sup>b</sup>
Low income (b)	89	56%	39%
<b>Housing type</b>			
Single family (c)	110	63%	55%
Multifamily (d)	60	61%	45%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.8 Pumps

Table 67 presents results on the penetration of different types of pumps at DESC homes.

- A low percentage of DESC homes have an irrigation pump (3%). A larger, percentage of homes have a well pump (17%).
- Single family residents are more likely to have a well pump than multifamily residents.

Table 67. Pumps penetration

	n	Well pump	Irrigation pump
Overall	170	17%	3%
<b>Income status</b>			
Non-low income (a)	81	17%	3%
Low income (b)	89	18%	5%
<b>Housing type</b>			
Single family (c)	110	20% <sup>d</sup>	3%
Multifamily (d)	60	8%	5%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.9 Pool

Table 68 presents results on the penetration of pools and pool pumps at DESC homes.

- Few DESC households have a pool (3%) and associated pool pump (3%). The low penetration of pools and pool pumps across residential customers would be a major limiting factor in the success of a pool targeted energy efficiency program.
- Non-low income and single family households are slightly more likely than their counterparts to have a pool.
- Those households with a pool all had an associated pool pump.

Table 68. Pool penetration

	n	Pool	Pool pump
Overall	170	3%	3%
<b>Income status</b>			
Non-low income (a)	81	4%	4%
Low income (b)	89	1%	1%
<b>Housing type</b>			
Single family (c)	110	4%	4%
Multifamily (d)	60	2%	2%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.10 Lighting

Table 69 presents results on the penetration of incandescent lighting and smart LED lighting in DESC homes. Due to the changes in the lighting market and manufacturing changes, the team focused on the penetration of remaining incandescent lighting and the newest smart LED lighting technology.

- A majority of households have incandescent lights (69%). Notably, this is a major decrease from 2016 when 91% of households had incandescent lights. Few homes have any smart LED lights (3%)
- Low income residents are more likely than non-low income residents to have incandescent lights.
- Single family residents are more likely than multifamily residents to have any smart LED lights.

Table 69. Lighting penetration

	n	Incandescent lights	Smart LED lights
Overall	170	69%	3%
<b>Income status</b>			
Non-low income (a)	81	67%	3%
Low income (b)	89	76% <sup>a</sup>	2%
<b>Housing type</b>			
Single family (c)	110	69%	4% <sup>d</sup>
Multifamily (d)	60	68%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.11 Faucet/Shower

Table 70 presents results on the penetration of different types of faucets and showers in DESC homes.

- Almost all households have a faucet (100%) and showerhead (99.8%). Approximately half of homes have a Home Energy Check-up (HEC) compatible faucet (53%). Energy efficient equipment wise, 33% of homes have a faucet aerator and 15% of homes have a low flow showerhead.
- Low income and multifamily residents are more likely than their counterparts to have a HEC compatible faucet.
- Non-low income and single family residents are more likely than their counterparts to have a faucet aerator or low flow showerhead.

Table 70. Faucet/Shower penetration

	n	Faucet	HEC compatible faucet	Faucet aerator	Showerhead	Low flow showerhead
Overall	170	100%	53%	33%	100%	15%
<b>Income status</b>						
Non-low income (a)	81	100%	50%	36% <sup>b</sup>	100%	16% <sup>b</sup>
Low income (b)	89	100%	64% <sup>a</sup>	20%	99%	8%
<b>Housing type</b>						
Single family (c)	110	100%	49%	37% <sup>d</sup>	100%	16%
Multifamily (d)	60	100%	65% <sup>c</sup>	18%	100%	13%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.12 Smart Strips/Dehumidifier

Table 71 presents results on the penetration of smart strips and dehumidifiers in DESC homes.

- Few homes have a smart strip (4%) or dehumidifier (6%).
- Low income and single family residents are more likely than their counterparts to have a smart strip and have devices plugged into said smart strip.
- Non-low income and single family residents are more likely than their counterparts to have a dehumidifier.

Table 71. Smart strips/dehumidifier penetration

	n	Dehumidifier	Smart strip	Devices plugged into smart strip
Overall	170	6%	4%	3%
<b>Income status</b>				
Non-low income (a)	81	7% <sup>b</sup>	3%	2%
Low income (b)	89	0%	6%	6% <sup>a</sup>
<b>Housing type</b>				
Single family (c)	110	7%	5% <sup>d</sup>	3% <sup>d</sup>
Multifamily (d)	60	2%	0%	0%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

### 8.13 Refrigerator/Dishwasher/Standalone Freezer

Table 72 presents results on the penetration of refrigerators, dishwashers, and standalone freezers in DESC homes.

- Most homes have a refrigerator (98%), over half of homes have a dishwashers (64%), and a sizable portion of homes have a standalone freezer (40%).
- Non-low income residents are more likely than low income residents to have a dishwasher.
- Single family residents are more likely than multifamily residents to have a standalone freezer.

Table 72. Refrigerator/dishwasher/standalone freezer penetration

	n	Refrigerator	Dishwasher	Standalone freezer
Overall	170	98%	64%	40%
<b>Income status</b>				
Non-low income (a)	81	98%	69% <sup>b</sup>	39%
Low income (b)	89	99%	43%	41%
<b>Housing type</b>				
Single family (c)	110	98%	62%	43% <sup>d</sup>
Multifamily (d)	60	100%	70%	30%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.14 Clothes Washer/Dryer

Table 73 presents results on the penetration of clothes washers and clothes dryers in DESC homes.

- Most homes have a clothes washer (91%) and clothes dryer (86%)
- Single family residents are more likely than multifamily residents to have laundry appliances in the home.
- Non-low income residents are more likely than low income residents to have a clothes dryer.

Table 73. Clothes washer/Clothes dryer penetration

	n	Clothes washer	Clothes dryer
Overall	170	91%	86%
<b>Income status</b>			
Non-low income (a)	81	91%	88% <sup>b</sup>
Low income (b)	89	90%	79%
<b>Housing type</b>			
Single family (c)	110	94% <sup>d</sup>	89% <sup>d</sup>
Multifamily (d)	60	81%	76%

Note: Results based on on-site data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.15 Electric Plug-In Equipment

Table 74 presents results on the penetration of electric lawn mowers and leaf blowers in DESC homes.

- Overall, 59% of residents have an electric lawn mower and 53% of resident have a leaf blower.
- Non-low income residents are more likely than low income residents to have a leaf blower.
- Single family residents are more likely than multifamily residents to have a lawn mower or leaf blower.

Table 74. Electric Lawn mower and leaf blower penetration

	n	Lawn mower	Leaf blower
Overall	412	59%	53%
<b>Income status</b>			
Non-low income (a)	286	59%	59% <sup>b</sup>
Low income (b)	126	58%	40%
<b>Housing type</b>			
Single family (c)	311	75% <sup>d</sup>	66% <sup>d</sup>
Multifamily (d)	101	8%	14%

Note: Results based on web survey data

a/b/c/d indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 8.16 Electric Vehicles

Table 75 presents results on the penetration of electric vehicles in DESC homes.

- Few homes have an electric vehicle (2%).
- Of the respondents that indicated having an electric vehicle, 53% indicated they had a battery electric vehicle and 47% indicated they had a plug-in hybrid electric vehicle.
- Of respondent that indicated having an electric vehicle, 13% indicated they had a charging station at their home.
- Of those respondents that indicated having an electric vehicle and off-street parking, 60% indicated having a dedicated 240V outlet where they parked their vehicle and 100% indicated having available circuits for a 40A 240V circuit.

Table 75 . Electric vehicle penetration

	n	Electric vehicle
Overall	414	2%
<b>Income status</b>		
Non-low income (a)	287	2%
Low income (b)	127	1%
<b>Housing type</b>		
Single family (c)	311	2%
Multifamily (d)	103	1%

Note: Results based on web survey data

a/b/c/d indicates significant differences at a 90% confidence level between the following tests: ab,cd

### 8.16.1 Electric Vehicles – Awareness and Attitudes

The Study Team asked respondents if they had ever heard of electric vehicles (EVs) prior to the survey. Table 76 presents the percentage of respondents that indicated being aware of EVs by customer segment.

- Overall, most respondents indicated they had heard of electric vehicles prior to the survey (93%).
- Non-low income respondents were significantly more likely than low income respondents to indicate they had heard about EVs prior to the survey (96% vs. 86%).

Table 76. Awareness of electric vehicles

	n	Heard of EVs
Overall	414	93%
<b>Income status</b>		
Non-low income (a)	287	96% <sup>b</sup>
Low income (b)	127	86%
<b>Housing type</b>		
Single family (c)	311	92%
Multifamily (d)	103	95%

Note: Results based on web survey data

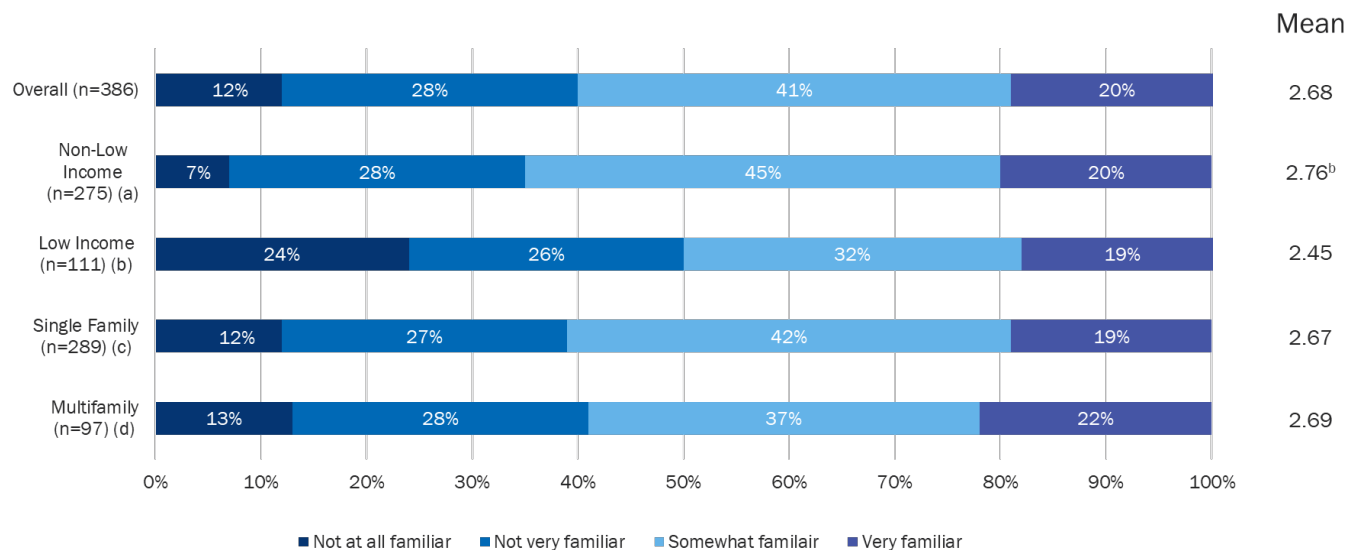
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked those respondents that indicated they had heard of EVs before, how they would rate their familiarity with EVs on a scale of 1 “not at all familiar” to 4 “very familiar”. Figure 17 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Of respondents that indicated hearing about EVs prior to the survey, 61% of respondents indicated being at least “somewhat familiar” with EVs. Less indicated that they were “not very familiar” (28%). Few respondents indicated that, although they had heard of EVs in the past, they were “not at all familiar” with the technology (12%).
- Respondents had an overall mean score of 2.68, indicating that average familiarity with EVs falls slightly below “somewhat familiar”.
- Non-low income respondents had a significantly larger mean score compared to low income respondents, indicating that non-low income respondents are more familiar with EVs than low income respondents.

Figure 17. Level of familiarity with electric vehicles



Note: Results based on web survey data – respondents that heard of EVs prior to the survey

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents if they plan on purchasing/leasing a new or used vehicle, and if so, how soon. Table 77 presents the percentage respondents that indicated planning to purchase/lease a vehicle across various time frames broken down by customer segment.

- Overall, 46% of respondents indicated that they planned on purchasing/leasing a vehicle within the next 5 years. One-quarter of respondents indicated they planned on purchasing/leasing a vehicle 5+ years in the future. Over one-quarter of respondents indicated they never plan on purchasing/leasing another vehicle (29%).
- Non-low income respondents were significantly more likely than low income respondents to indicate they planned on purchasing a vehicle 3+ years in the future.
- Low income respondents were significantly more likely than non-low income respondents to indicate that they never planned on purchasing another vehicle.

Table 77. Expectancy to purchase/lease a vehicle

	n	During the next 12 months	Between 1 year to 2 years from now	Between 2 years to 3 years from now	Between 3 years to 5 years from now	Between 5 years to 10 years from now	More than 10 years from now	Never
Overall	324	10%	11%	8%	17%	16%	9%	29%
<b>Income status</b>								
Non-low income (a)	234	9%	12%	9%	22% <sup>b</sup>	19% <sup>b</sup>	10% <sup>b</sup>	18%
Low income (b)	90	11%	8%	4%	7%	11%	5%	54% <sup>a</sup>
<b>Housing type</b>								
Single family (c)	244	9%	10%	8%	18%	18%	8%	29%
Multifamily (d)	80	13%	12%	8%	16%	11%	12%	28%

Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents that indicated they planned on purchasing/leasing a vehicle in the next five years if they planned on choosing to purchase/lease an EV. Table 78 presents the percentage of respondents that indicated they would purchase an EV.

- Overall, 20% of respondents in the market for a vehicle in the next 5 years indicated they would purchase/lease an EV.
- Multifamily respondents were significantly more likely than single family respondents to indicate that they planned on purchasing/leasing an EV.

Table 78. Expectancy to purchase/lease an electric vehicle

	n	Purchase/lease EV
Overall	152	20%
<b>Income status</b>		
Non-low income (a)	123	21%
Low income (b)	29	16%
<b>Housing type</b>		
Single family (c)	114	16%
Multifamily (d)	38	30% <sup>d</sup>

Note: Results based on web survey data – respondents purchasing/leasing a vehicle in the next 5 years

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents that indicated they planned on purchasing/leasing an electric vehicle within the next five years to specify what type of electric vehicle they planned on choosing. Table 79 presents the percentage of respondents that indicated they would purchase each type of EV.

Table 79. Type of electric vehicle expected to purchase/lease

	n	Battery electric vehicle	Plug-in hybrid vehicle
Overall	19	58%	42%
<b>Income status</b>			
Non-low income (a)	15	48%	52%
Low income (b)	4	100%	0%
<b>Housing type</b>			
Single family (c)	11	48%	52%
Multifamily (d)	8	70%	30%

Note: Results based on web survey data – respondents purchasing an EV in the next 5 years

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

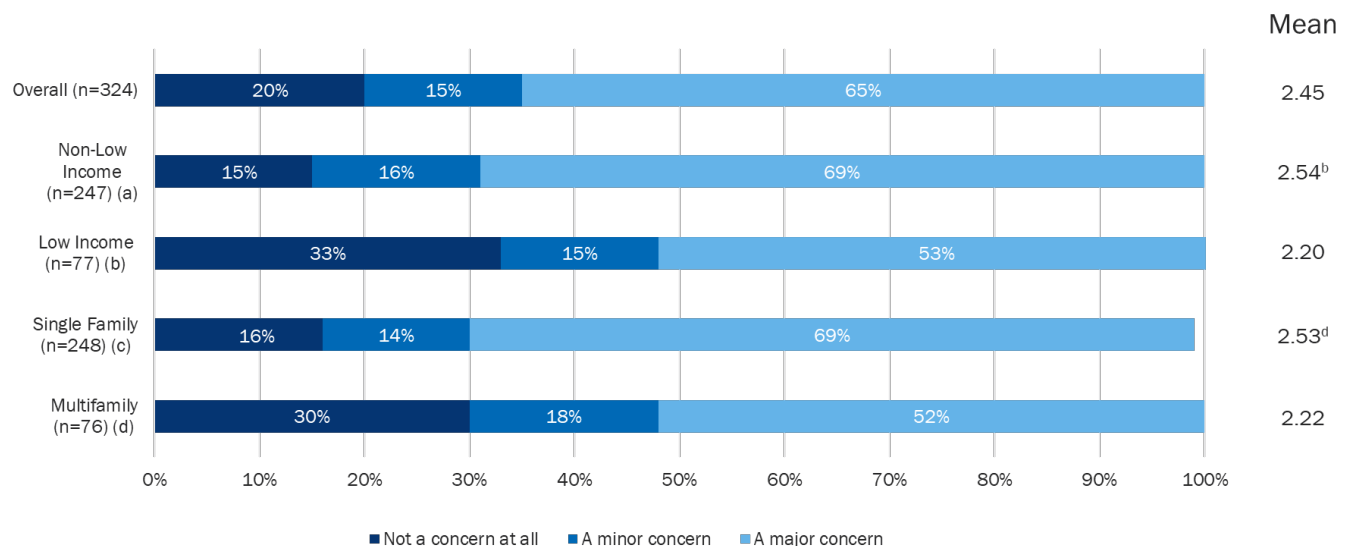
## Key Penetration Results

The Study Team presented respondents several factors that one may consider when deciding to purchase/lease an EV. The Study Team asked respondents to rate how much of a concern each factor was on a scale of 1 “not a concern at all” to 3 “a major concern”.

The Study Team asked respondents to indicate their level of concern regarding how many miles an EV can go on a single charge. Figure 18 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 80% of respondents indicated that the number of miles EVs get on a single charge was a concern to them, with 65% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.45, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Non-low income and single family respondents had higher mean scores compared to low income and multifamily respondents, suggesting that the number of miles EVs can go on a single charge was of greater concern to them than their counterparts.

Figure 18. Concern with mileage on a single charge



Note: Results based on web survey data

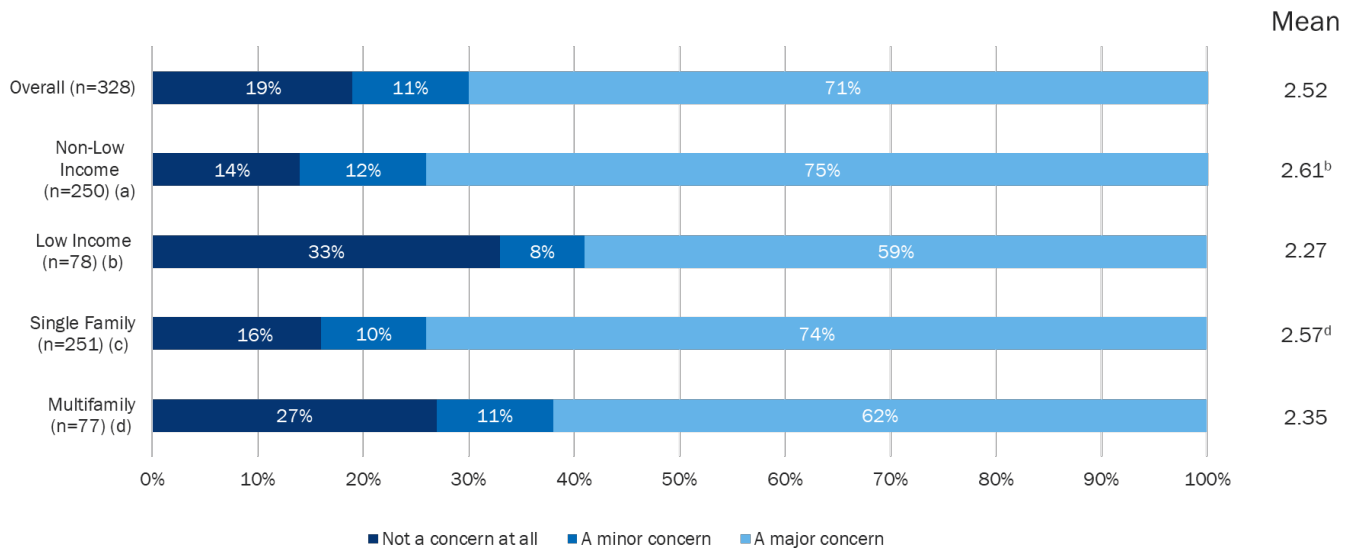
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked respondents to indicate their level of concern regarding the price of EVs, charging station installation costs, maintenance costs, and charging costs. Figure 19 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 81% of respondents indicated that the costs associated with purchasing/leasing and maintaining an EV was a concern to them, with 71% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.52, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Non-low income and single family respondents had higher mean scores compared to low income and multifamily respondents, suggesting that the costs associated with purchasing/leasing and maintaining an EV were of greater concern to them than their counterparts.

Figure 19. Concern with price of electric vehicle, charging station installation, maintenance costs, charging costs



Note: Results based on web survey data

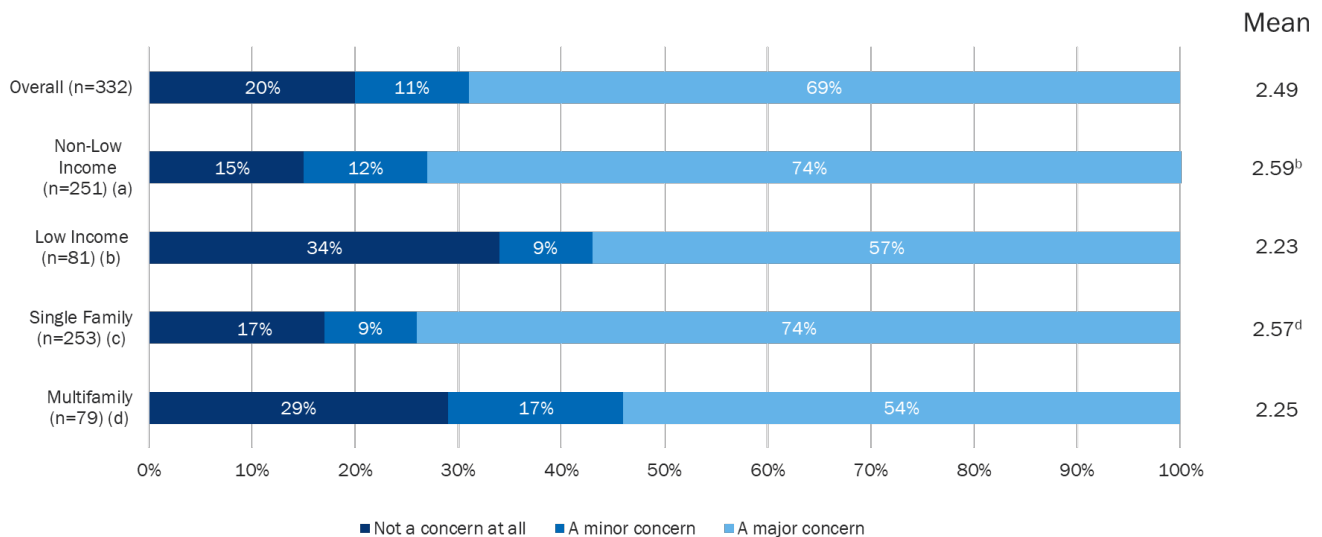
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked respondents to indicate their level of concern regarding the availability of public/workplace charging. Figure 20 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 80% of respondents indicated that the availability of public/workplace charging was a concern to them, with 69% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.49, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Non-low income and single family respondents had higher mean scores compared to low income and multifamily respondents, suggesting that the availability of public/workplace charging was of greater concern to them than their counterparts.

Figure 20. Concern with availability of public/workplace charging



Note: Results based on web survey data

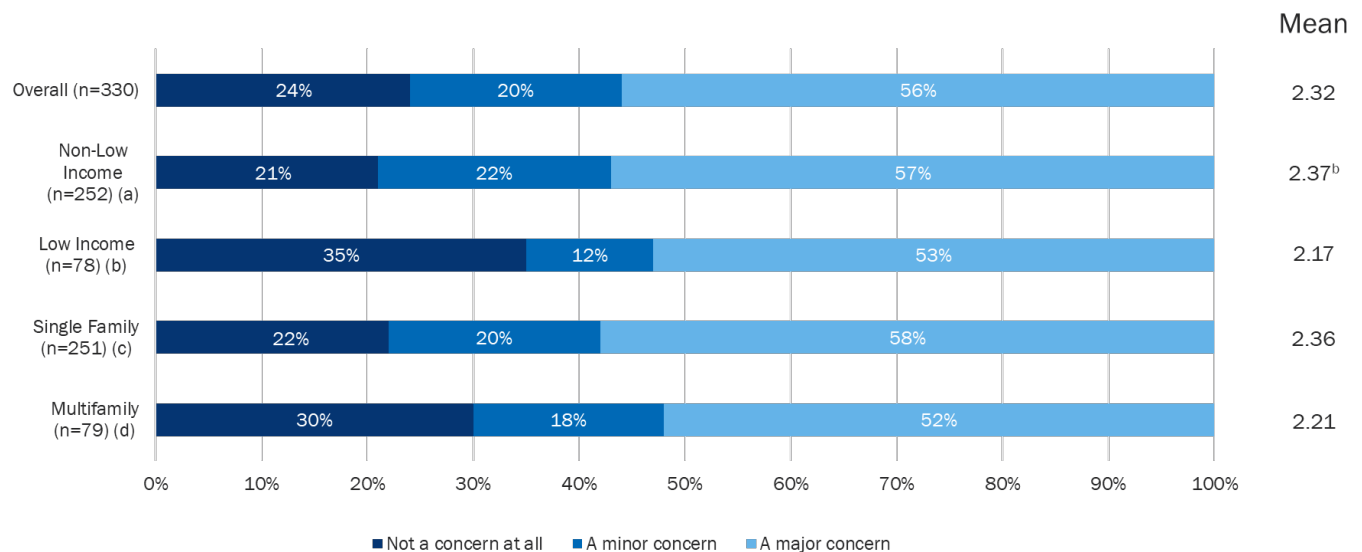
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked respondents to indicate their level of concern regarding the ability to charge at home. Figure 21 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 76% of respondents indicated that the ability to charge at home was a concern to them, with 56% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.32, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Non-low income respondents had higher mean scores compared to low income respondents, suggesting that the ability to charge at home was of greater concern to non-low income respondents than it was to low income respondents.

Figure 21. Concern with ability to charge at home



Note: Results based on web survey data

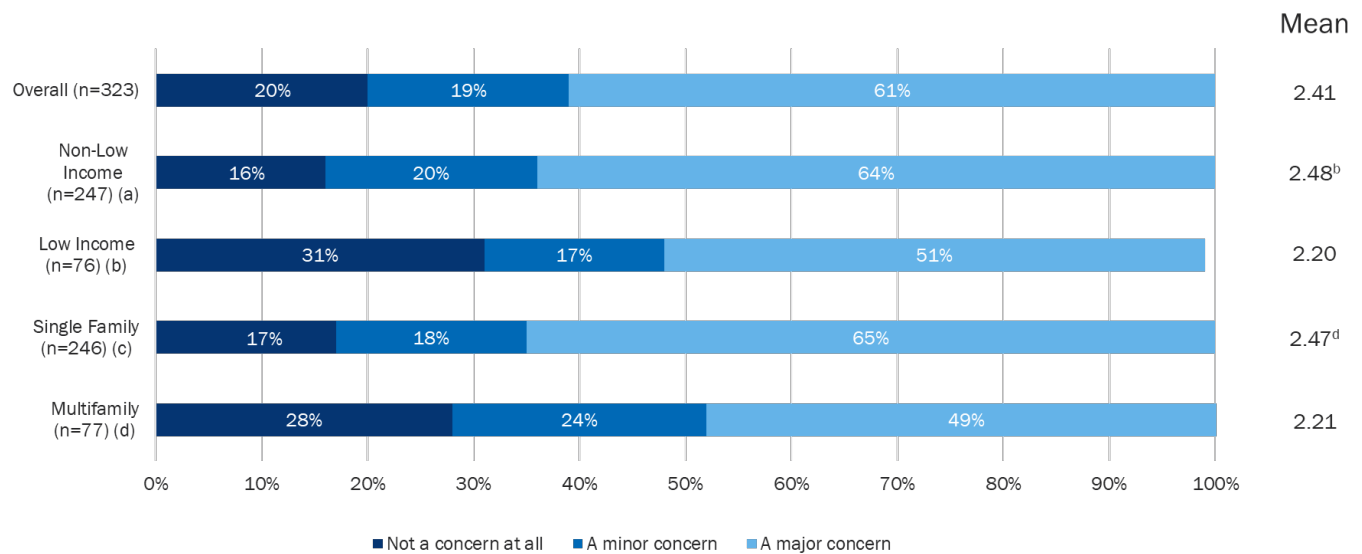
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked respondents to indicate their level of concern regarding the amount of time required to charge an EV. Figure 22 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 80% of respondents indicated that the time required to charge was a concern to them, with 61% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.41, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Non-low income and single family respondents had higher mean scores compared to low income and multifamily respondents, suggesting that the time it takes to charge an EV was of greater concern to them than their counterparts.

Figure 22. Concern with amount of time required to charge



Note: Results based on web survey data

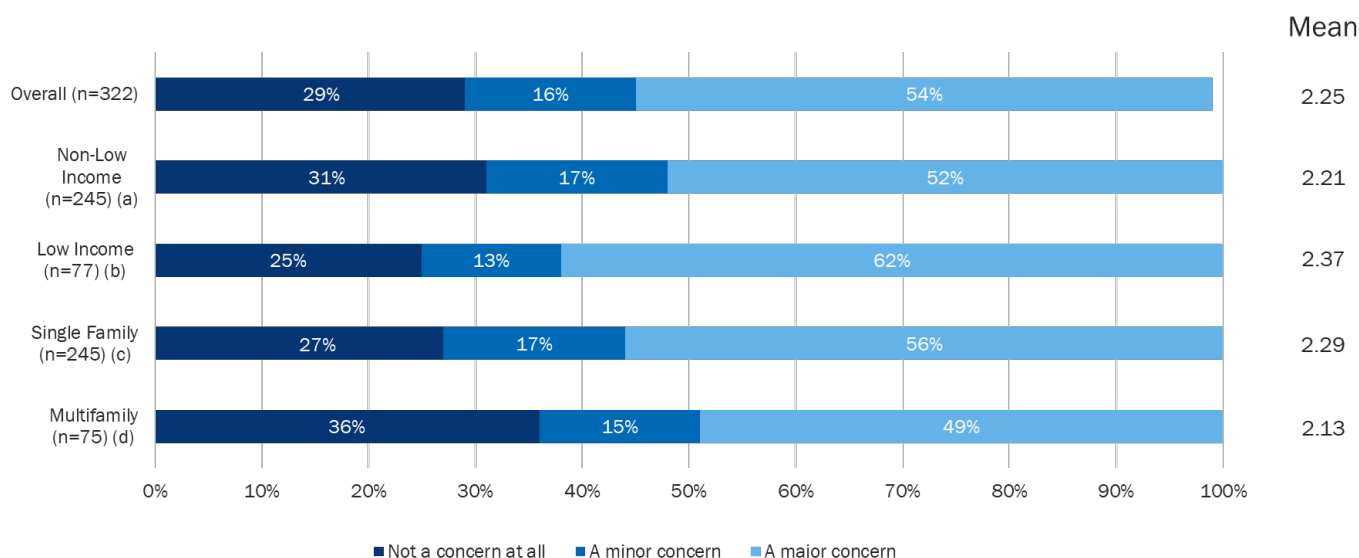
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## Key Penetration Results

The Study Team asked respondents to indicate their level of concern regarding the safety of EVs. Figure 23 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 71% of respondents indicated that the safety of EVs was a concern to them, with 54% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.25, indicating that their average level of concern falls between “a minor concern” and “a major concern”.

Figure 23. Concern with electric vehicle safety



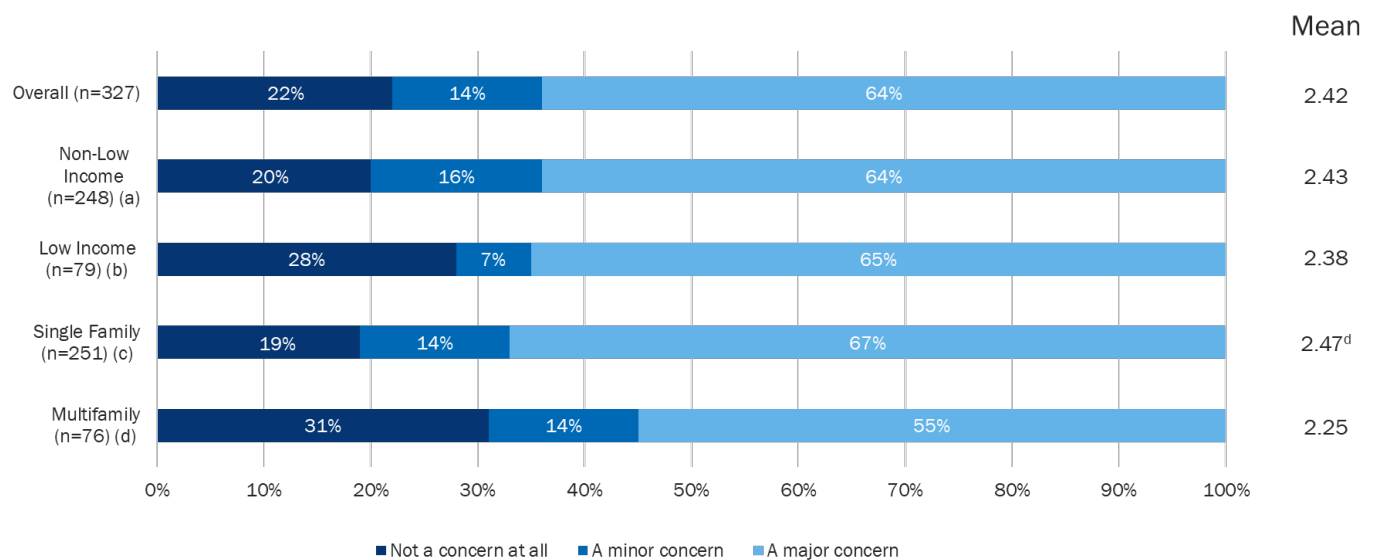
Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked respondents to indicate their level of concern regarding the reliability of EVs. Figure 24 presents the frequency of each response by percentage and mean score, broken down by customer segment.

- Overall, 78% of respondents indicated that the reliability of EVs was a concern to them, with 64% indicating it was “a major concern”.
- Respondents had an overall mean score of 2.42, indicating that their average level of concern falls between “a minor concern” and “a major concern”.
- Single family respondents had higher mean scores compared to multifamily respondents, suggesting that the reliability of EVs was of greater concern to single family respondents than it was to multifamily respondents.

Figure 24. Concern with electric vehicle reliability



Note: Results based on web survey data

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

## 9. Summary of EE Residential Adoption Curve Results

This section provides residential adoption curve results for non-low income and low income segments and single family and multifamily segments. These results are estimated based on respondents' willingness-to-participate and are adjusted by financial barriers, non-financial barriers and awareness. These estimates serve as the starting point for the adoption inputs into DESC's 2022 DSM potential model.

### 9.1 EE HVAC Adoption Results

Table 80 displays the residential adoption curves for energy efficient HVAC systems broken down by income status (non-low Income and low income) and housing type (single family and multifamily).

- EE HVAC adoption rates for non-low Income trended higher than adoption rates for low income across all incentive levels, differing by 8% at 0% incentive and 13% at 100% incentive. This suggests that, when deciding about replacing a broken HVAC with an EE HVAC, non-low Income customers are less influenced by financial and non-financial barriers and are more likely to adopt EE HVAC technology compared to low income customers
- EE HVAC adoption rates for single family trended higher than adoption rates for multifamily across all incentive levels, differing by 5% at 0% incentive and 10% at 100% incentive. This suggests that, when deciding about replacing a broken HVAC with an EE HVAC, single family customers are less influenced by financial and non-financial barriers and are more likely to adopt EE HVAC technology compared to multifamily customers
- EE HVAC adoption rates shows consistent growth with increasing incentive level, with overall adoption increasing from 15% at 0% incentive to 42% at 100% incentive. An adoption rate below 50% at 100% incentive suggests that a lack of DESC program awareness and/or the presence of significant non-financial barriers are roadblocks to EE HVAC adoption regardless of incentive level.

Table 80. Adoption curve results – HVAC

		Incentive level				
	n	0%	25%	50%	75%	100%
<b>HVAC</b>						
Overall	294	15%	22%	28%	34%	42%
<b>Income status</b>						
Non-low income	229	18%	24%	31%	38%	46%
Low income	65	10%	17%	21%	25%	33%
<b>Housing type</b>						
Single family	269	16%	22%	28%	34%	43%
Multifamily	25	11%	18%	23%	26%	33%

Note: Results based on web survey data

## 9.2 Heat Pump Water Heater Adoption Results

Table 81 displays the residential adoption curves for heat pump water heaters broken down by income status (non-low income and low income) and housing type (single family and multifamily).

- Heat pump water heater adoption rates do not majorly differ between low income and non-low income regardless of incentive level. This suggests that, when deciding about replacing a broken water heater with a heat pump water heater, customers are similarly influenced by barriers and similarly likely to adopt EE water heating regardless of income status.
- Heat pump water heater adoption rates for multifamily trended higher than adoption rates for single family across all incentive levels, differing by 8% at 0% incentive and 14% at 100% incentive. This is partially due to multifamily having a higher awareness adjustment (63%) compared to the single family (45%). Initiatives to increase heat pump water heater technology awareness, especially targeted towards single family households, could increase the overall rate of adoption.
- Heat pump water heater adoption rates show consistent growth with increasing incentive level, with overall adoption increasing from 11% at 0% incentive to 40% at 100% incentive. An adoption rate below 50% at 100% incentive suggests that a lack of DESC program awareness and/or the presence of significant non-financial barriers are roadblocks to heat pump water heater adoption regardless of incentive level (Table 81).

Table 81. Adoption curve results - water heating

		Incentive level				
	n	0%	25%	50%	75%	100%
<b>Water heating</b>						
Overall	168	11%	18%	25%	31%	40%
<b>Income status</b>						
Non-low income	124	11%	17%	25%	33%	40%
Low income	44	10%	21%	24%	28%	40%
<b>Housing type</b>						
Single family	145	10%	17%	23%	29%	38%
Multifamily	23	18%	27%	36%	44%	52%

Note: Results based on web survey data

### 9.3 Updated Insulation/Air Sealing Adoption Results

Table 82 displays the residential adoption curves for insulation and air sealing broken down by income status (non-low income and low income) and housing type (single family and multifamily).

- Improved insulation adoption rates for single family consistently trended higher than adoption rates for multifamily across all incentive levels, differing by 5% at 0% incentive and 9% at 100% incentive. This suggests that, when deciding about making insulation and air sealing improvements, single family customers are less influenced by financial and non-financial barriers and more likely to make insulation/air sealing improvements compared to multifamily customers.
- Improved insulation adoption rates at 0% incentive were low regardless of income status. However, as the incentive level increased, the adoption rate for non-low income increased more than the adoption rate for low income. At 0% incentive there was a 1% difference in adoption with non-low income trending marginally higher. This gap increased as the incentive level increased, ending with 46% adoption for non-low income and 36% adoption for low income at a 100% incentive level (a 10% difference). This suggests that financial incentives were more influential to non-low income customers than they were to low income customers.
- Improved insulation adoption rates show consistent growth with increasing incentive level, with overall adoption increasing from 9% at 0% incentive to 43% at 100% incentive. An adoption rate below 50% at 100% incentive suggests that a lack of DESC program awareness and/or the presence of significant non-financial barriers are roadblocks to improving insulation adoption regardless of incentive level.

Table 82. Adoption curve results – insulation

		Incentive level				
	n	0%	25%	50%	75%	100%
<b>Insulation</b>						
Overall	299	9%	19%	26%	34%	43%
<b>Income status</b>						
Non-low income	232	9%	20%	29%	37%	46%
Low income	67	8%	18%	21%	28%	36%
<b>Housing type</b>						
Single family	273	9%	20%	27%	35%	44%
Multifamily	26	4%	13%	21%	27%	35%

Note: Results based on web survey data

## 10. Summary of Low Income Program Design & Community Partnerships

The Study Team collected additional data to better understand the unique needs and barriers of DESC's low income customer base through a focused literature review, in depth interviews with community leaders serving low income communities, DESC staff interviews, and specific questions on the web survey. Table 83 summarizes the research questions, key findings, and recommendations from the deep dive.

Table 83. Summary of low income deep dive findings and recommendations

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
<b>Energy burden and insecurity</b>		
<p>What level of energy burden and insecurity do these customers experience?</p> <p>What are the unique conditions and needs of these customers? What sorts of needs, energy-related or non-energy-related, do these customers have that must be addressed before or in tandem with energy efficiency upgrades?</p>	<p><b>Energy Burden:</b> Low income customers have a significantly higher average energy burden (total annual costs as a percentage of annual income) than non-low income customers (12.0% vs 3.9%).</p> <p><b>Non-energy-related Needs:</b> Despite high energy burdens, energy costs are ultimately a mid-tier priority for low income households. About half of households (53%) are highly concerned with their energy costs; and many have made sacrifices to other essential needs to pay them (47% did so). However, they are typically unable to invest the time or money into managing them proactively (e.g., through upgrades) amidst other competing priorities. Most low income survey respondents spent their 2020 stimulus money on household essentials (70%) and/or paying down debt (30%); far more so than home and equipment upgrades (12%). They provided similar responses when asked what they would do with another \$1,000 theoretical stimulus.</p> <p><b>Economic Insecurity:</b> As expected, low income households experience greater economic hardship than non-low income customers. They had a statistically higher average economic hardship score (6.2 out of 10) compared to non-low income (4.5) (see Section 6. for more detail on this index). Further, low income respondents were significantly more likely to have some concern about paying energy bills (66% versus 28%); paying rent or mortgage (40% versus 21%); and buying groceries/household necessities (47% versus 24%).</p> <p><b>Health Hardship:</b> Low income household also experience slightly higher health hardship than non-low income households: the average health hardship score amongst low income respondents was a 3.8 out of 10; compared to a 3.1 out of 10 for non-low income. Though not the majority overall, low income households were more likely than non-low income households to report health, comfort, and safety (HCS) issues in their home, such as mold/fungus, pests, and uncomfortable temperatures. However, limitations in addressing HCS</p>	<ol style="list-style-type: none"> <li>1. DESC should continue to address their low income customers' energy burden through energy upgrades, but also seek ways to address their financial and health insecurity issues, where possible. First and foremost, continue with plans to increase low income customer participation in DESC programs and seek ways to increase the comprehensiveness of the measures DESC provides through NEEP or a new program offering. As a second, critical strategy, establish partnerships with community organizations that can package DESC programs with their other social, financial, or HCS assistance services; thereby tackling energy and non-energy related needs in tandem.</li> <li>2. To avoid project deferrals due to HCS issues, where possible, allow for small and expedient repairs and remediation in special circumstances. DESC takes this approach with the manufactured home weatherization offering and should continue to do so with any additional weatherization offerings.</li> </ol>

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
	issues with utility demand-side management (DSM) or Weatherization Assistance Program (WAP) funding is a long-standing challenge in the industry.	
<b>Energy-related needs</b>		
What are building and technology characteristics of these customers' homes and how do they differ from other customers?	<p><b>Housing Type:</b> More than half (55%) of low income respondents live in a single family homes, but were statistically more likely than non-low income respondents to live in a mobile/manufactured home (20% vs. 5%).</p>	<p>3. Add a low income weatherization offering targeting low income single family homes or expand existing offering(s).</p> <p>4. Continue to offer a mobile home weatherization component of NEEP. Consider whether it is possible to expand the annual goals of that offering by targeting more communities each year.</p> <p>5. Track the number of low income properties and/or units that DESC serves through the new Multifamily Program. After a few years of implementation, assess whether a specific Low Income Multifamily offering is necessary.</p>
What energy upgrades are most needed in the segment?	<p><b>Energy-using Equipment:</b> The site visits found that, compared to non-low income respondents, low income respondents are:</p> <ul style="list-style-type: none"> <li>▪ Slightly more likely to have gas heating as a primary source, either central forced air furnaces (29% vs. 26%) or gas packs (20% vs. 10%)</li> <li>▪ More likely to have portable heating (14% vs. 3%) as primary source of heating</li> <li>▪ Less likely to have central cooling, either a central air conditioner (82% vs. 92%) or air source heat pumps (41% vs. 56%)</li> <li>▪ More likely to have portable cooling, either a portable fan (3% vs. 0%), or a portable air conditioner (17% vs. 8%) as primary source of cooling</li> <li>▪ More likely to have a manual thermostat (80% vs 64%); very few (6%) DESC customers overall have smart thermostats</li> <li>▪ More likely to have a storage (tank) water heater (94% vs. 86%)</li> <li>▪ Less likely to have insulation in crawlspaces (18% vs 35%) and attics (39% vs. 56%)</li> <li>▪ More likely to have inefficient (incandescent) lighting (76% vs. 67%)</li> <li>▪ More likely to have standard faucets that are compatible with the Home Energy Check-up (HEC) Programs' twist-on faucet aerator measure (64% vs. 50%); but less likely to have an aerator already (20% vs. 36%) or a low-flow showerhead (8% vs. 16%).</li> </ul>	<p>6. Continue with plans to add gas DSM offerings to DESC's portfolio. Prioritize adding gas DSM to current or future low income program offerings, given the higher prevalence of gas-using equipment in low income homes.</p> <p>7. Continue to directly replace incandescent lamps with LEDs. Providing kits of LEDs may still be a feasible strategy but will result in less savings than direct install to account for some homes (about a third) already having LEDs.</p> <p>8. If not already offered, include crawlspace and attic insulation in any future weatherization offering. There may be other insulation opportunities, such as wall insulation, that were not observable during site visits.</p> <p>9. Continue to provide low-flow faucet aerators through NEEP and continue with plans to add low-flow showerheads to NEEP.</p>
How well aligned are program strategies with the needs of these customers?		

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
	<ul style="list-style-type: none"> <li>Less likely to have dishwashers (43% vs. 69%) or clothes dryers (79% vs. 88%); but most have clothes washers and dryers overall.</li> </ul>	<p>10. Consider ways to deliver no-cost smart thermostats to low income customers. Installing smart thermostats may not be feasible during NEEP home visits (given time constraints). DESC should consider a kit/direct distribution effort targeting NEEP neighborhoods. To encourage installation, consider offering an incentive upon activation or free contractor installation; similar to Ameren Illinois' Smart Savers offering. Smart thermostats could also be a part of a future low income weatherization program.</p>
Program design		
<p>Given the needs of and barriers facing these customers, are there other strategies or partnerships DESC should consider?</p> <p>Do the current DESC partners offer these services, or would DESC need to seek new partnerships?</p> <p>What other sources of funding for LI could be leveraged by DESC EE programs?</p>	<p><b>Common Program Designs:</b> Utilities offer a variety of different types of low-income programs, the primary designs being: 1) weatherization programs leveraging a utility-WAP partnership; 2) utility-only weatherization programs; 3) neighborhood canvassing; and 4) kits or other direct distribution efforts. DESC already offers three of the four types through NEEP, with the exception being a utility-WAP partnership. DESC's utility-only weatherization offerings is small-scale, and only available to mobile homes.</p> <p><b>A Portfolio Approach:</b> The most inclusive program design, which is gaining in popularity, is a "portfolio" approach that includes a combination of these program offerings (i.e., Ameren Illinois Income Qualified Initiative case study). This design allows utilities to offer a comprehensive set of services to better meet the diverse needs of low-income customers and provide the greatest benefits.</p> <p><b>Streamlined Participation:</b> Best practices and current trends in the industry that can help increase low income program participation include 1) aligning eligibility criteria with other income-qualified programs (e.g., WAP and the Low Income Home Energy Assistance Program [LIHEAP]); and 2) making program participation as easy as possible for the customer from start to finish.</p> <p><b>Community Action Program (CAP) Partnerships:</b> Utilities can partner with CAP agencies to bundle or "braid" their original program allocated funds with WAP funding to provide services that result in greater benefits to the customers and the homes.</p>	<p>11. Continue offering NEEP canvassing, low-income kits, and mobile home weatherization offerings as features within DESC's low-income program design.</p> <p>12. Broaden DESC's current mobile home weatherization offering or consider creating a second, utility-only weatherization program for single family homes. Consider beginning with measure offerings similar to HEC Tier 2, and steadily add additional measures, such as heating and cooling tune-ups or upgrades and appliance or refrigerator replacements.</p> <p>13. Add a utility-WAP offering to DESC's low income program "portfolio." DESC should work with the South Carolina Association of Community Action Programs (SCACAP) to determine exactly the partnership and funding should operate. SCACAP already has such a partnership with Duke Energy Carolinas (DEC), and DESC should consider a similar model.</p> <p>14. Create a "portfolio" low-income program design encompassing the existing NEEP canvassing, low-income kits and mobile home weatherization offerings with the new or expanded weatherization offerings</p>

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
	<p><b>Augment Other Organizations' Funding and Services:</b> Utilities often do not qualify for state and federal funding sources on their own. As such, they access this funding indirectly through partnerships with local governments, CAPs, or other community-based organizations (CBOs) who do qualify. Once these partnerships are established, the community partner will also be able to package the program with the other support services (e.g., social services, LIHEAP, other non-energy-related programs) they provide to residents.</p> <ul style="list-style-type: none"> <li>Community Partnerships: The literature review revealed a number of best practices for community partnerships (see Section 10 for more detail).</li> <li>Select partners who share common goals with the utility and/or already serve the customer groups DESC would like to target.</li> <li>Establish realistic expectations for the types of support the partner can provide (and what support is needed from DESC) based on the partners' resources.</li> <li>Develop marketing materials for the partners but leave room for customization</li> <li>Monitor and reduce partners' administrative costs, where possible, to ensure that the partner can maximize the use of funding towards direct customer benefits.</li> </ul>	<p>recommended above. Use NEEP canvassing and low-income kits as a foot in the door to larger program offerings. Consider providing physical collateral in kits or during canvassing visits, or, potentially including the weatherization offerings' home audit during the NEEP canvassing visit.</p> <p>15. Continue to offer NEEP and any future low income offerings to any household with annual income 200% or lower than the federal poverty guideline (FPL), by household size. This aligns with WAP criteria for weatherization assistance. Customers can also receive additional LIHEAP bill payment assistance if they are 150% of the FPL or lower.</p> <p>16. Simplify the customer journey through this future portfolio by aligning application processes, where possible, with WAP and LIHEAP and/or by having a single point of contact (i.e., a concierge) for each participating customer to limit confusion and the time and effort required.</p> <p>17. Establish partnerships with CBOs who can access other federal, state, and local funding and who already serve low income customers and/or other hard-to-reach subgroups that DESC would like to target. See Appendix G for specific community partnership opportunities that leaders in Charleston, Aiken, and Saluda recommended. When establishing a partnership, adhered to the best practices discussed in section 9.1.5.</p>
Barriers to participation and community engagement strategies		

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
<p>What barriers do these customers experience that limit their involvement in current DESC programs?</p> <p>How do these relate to owner/renter status and geography? Culture and language?</p> <p>What customer engagement approaches are most appropriate and effective for these customers?</p>	<p><b>Historic Participation Trends:</b> Similar proportions of low income and non-low income customers have participated in DESC's programs overall (17%). As expected most low income participation occurs through NEEP; as well as some of the other no-cost offerings, such as Business Office Lighting (BOL) and Free LED Kits. Low income participation in other residential programs that include customer costs is lower across the board compared to non-low income.</p> <p><b>Awareness is a major barrier to participation.</b> Low income customers are statistically less aware of DESC programs overall (33%) compared to non-low income customers (44%).</p> <p><b>Upfront Cost and Time:</b> Low income customers generally had more potential structural household barriers that limit the time and disposable income they have to participate in DESC programs. They were statistically more likely than non-low income respondents to have children in the home (39% versus 23%) and have more people living in the home (2.9 versus 2.2 occupants, on average). When asked about HVAC, insulation, and water heater upgrades specifically, low income respondents reported statically greater barriers than non-low income respondents related to the price and access to financing.</p> <p><b>Decision-making power and Knowledge:</b> Low income customers were more likely to rent their homes compared to non-low income customers (76% vs. 50%), suggesting that many may not be able to complete home upgrades without landlord approval. Further, when asked about HVAC, insulation, and water heater upgrades specifically, low income respondents faced statically greater barriers than non-low income respondents related to knowledge and resources: they face greater difficulty finding information on energy efficient options or finding qualified contractors; and they are less knowledgeable about the potential benefits (energy savings and property values) that energy upgrades may provide.</p> <p><b>Language:</b> Lack of English language proficiency is not widespread in South Carolina but is a major barrier in specific communities. For example, in Saluda, even Spanish language materials may not reach the growing Guatemalan population in that community, who speak a tribal dialect called Mam and cannot read or write in Spanish.</p>	<p>18. Develop additional no-cost program offerings that are broadly available to all low income residential customers and promote these programs through targeted marketing to NEEP-qualifying neighborhoods and through local community partners who provide a range of other social and financial support services.</p> <p>19. Prepare for significant barriers related to getting approval from landlords of single family homes. Consider whether it would be possible to still offer a no-cost program to low-income households whose landlords are not low income. If this is not possible, consider conducting primary research with landlords to identify potential solutions. For example, DESC could conduct focus groups with landlords to workshop possible program and incentive designs and marketing messaging strategies.</p> <p>20. Identify and work with partners in target communities who are knowledgeable about the most common non-English languages spoken. Based on their expertise, develop the appropriate types of in-language marketing materials for each community.</p>
	<p>The most commonly reported outreach methods from community leader interviews was DESC involvement in the community and DESC partnerships with trusted community organizations such as CAPs or CBOs.</p>	<p>21. Promote DESC staff's physical presence in communities by attending community events run by local organizations and/or establishing more formal ME&amp;O (marketing, education and</p>

Research question(s)	Key findings	Recommendations for future low income program design and community engagement strategies
	<p><b>Community Engagement Best Practices:</b> There is no one-size-fits all solution for community engagement and strategies should be tailored to specific communities. However, the literature review and interviews with community leaders in Charleston, Aiken, and Saluda revealed a number of cross-cutting best practices (see Section 10 for more detail):</p> <ul style="list-style-type: none"> <li>Establish presence and recognition in the community in order to build relationships and trust among the low income population.</li> <li>Leaders from the smaller or more rural communities, Aiken and Saluda, particularly emphasized the need for face-to-face interactions and personalization in communication. Leaders noted the “close knit” relationships that trust is built upon, and how lack of recognition is likely to result in skepticism and unresponsiveness toward program offerings.</li> <li>Leaders emphasized the need to use a mixture of marketing, education, and outreach ME&amp;O tactics, and in some cases a mixture of languages, depending on who you are trying to reach.</li> <li>Highlight program benefits through testimonials.</li> </ul> <p><b>Trusted Messengers:</b> The survey found that low income and non-low income customers are similar in that only a third of respondents in each of these groups would look to DESC for assistance with their monthly energy bill. However, these groups differ in where they would look instead: low income respondents reported they would seek assistance from social services at a significantly higher rate (11%) than non-low income respondents (0%). Literature review results and community leaders both suggest that meeting customers where they already go for support is an effective engagement strategy; especially for hard-to-reach groups.</p>	<p>outreach) partnership (e.g., co-branding, co-conducting campaigns) with these organizations.</p> <p>22. Segment the market and consider demographics of the target population you are trying to reach before implementing various direct (i.e., mail, phone, text) or indirect (i.e., social media, radio) outreach approaches. Continue to rely on local DESC staff and/or partners for input on the most appropriate ME&amp;O approaches for specific communities.</p> <p>23. Include testimonials or “customer success stories” in marketing materials. Craft these materials with a particular target group or community in mind. A key to success is ensuring the testimonials are relatable to the target customer by showcasing the successes of similar customers.</p>

This next section provides findings from our literature review on low income program design and community engagement strategies, as well as in-depth interviews with community leaders in Charleston, Aiken, and Saluda.

## 10.1 Common Program Designs

The team reviewed of low income program designs offered by 15 utilities, across 15 states (see Appendix E) for a full list of sources and programs reviewed). Based on this research, the team found that most programs' offerings fall into at least one of four categories in Table 84. Six of the fifteen utilities provide more than one of these offering types through their program. Among the utilizes the team reviewed, low income weatherization was the most common offering and neighborhood canvassing was the least common. Kit and direct distribution offerings became more common throughout the COVID-19 pandemic, as they allowed utilities to provide customers with energy efficiency measures with little or no in-person contact. However, many utilities plan to continue to offer kits post-pandemic. Following the table are examples of these program designs from utilities the team reviewed.

Table 84. Common Low Income Program Designs

Offering Type	Offering Description	Count of Utilities Providing Offering
Weatherization programs with utility-WAP partnership	Home energy audit with direct install followed by more comprehensive weatherization, and sometimes HVAC, upgrades. Where cost-effective, projects may include minor repairs and health and safety remediation necessary to complete the upgrades. All repairs and upgrades are typically made at no cost to the customer and utilize a combination of utility and Weatherization Assistance Program (WAP) funding. Community Action Program (CAP) agencies (or similar organizations) implement these programs on behalf of the utility. CAPs typically leverage the additional utility funding to serve more homes with energy upgrades than they otherwise could with WAP funding alone. CAPs also package the program with their other non-energy-related financial support and/or social services to address as many issues as possible.	8
Utility-only Weatherization Program	Similar core design as above (audit with direct install, followed by comprehensive upgrades) but does not partner with CAPs or leverage WAP funding. As such, services are typically limited to energy efficiency upgrades only and, where cost-effective, minor repairs and health and safety remediation necessary to complete projects. For some programs, comprehensive upgrades may require copayments, depending on the customer's income.	6

Offering Type	Offering Description	Count of Utilities Providing Offering
Kits and Other Direct Distribution Efforts	Involves direct distribution of “kits” with one or more energy efficiency measures at no cost to the customer. Measures included within this type of offering tend to be easy to install, such as LED light bulbs, faucet aerators, smart power strips, etc. at no cost to the customer.	4
Neighborhood Canvassing	Usually targeted at a specific neighborhood within a community. Program staff go door-to-door offering brief home visits and no-cost direct-install energy efficient measures such as LED light bulbs and low-flow domestic hot water measures. These programs often partner with local organizations or leaders to implement or otherwise promote and lend credibility to the program.	3

Note: Count of utilities exceed 15 because some utilities provide more than one of the above offerings within their program.

## Weatherization Programs with Utility-WAP Partnership

**Duke Energy Carolinas’ (DEC)** Low Income Weatherization Program combines utility and federal/state (i.e., either North or South Carolina) WAP funding to provide energy efficiency upgrades to single-family low income DEC customers. The program offers a wide range of measures, but projects typically include air sealing; ductwork; insulation; lighting upgrades; HVAC repairs and tune-ups; and/or energy education. These services are at no cost to the customer and, to qualify, customers must have annual household incomes of less than 200% of the Federal Poverty Level (FPL), by household size (i.e., identical to the Low Income Home Energy Assistance Program [LIHEAP] guidelines).

CAPs provide all customer-facing services, with no direct involvement from DEC. In the South Carolina portion of DEC’s territory, DEC works directly with the South Carolina Association of Community Action Programs (SCACAP) as an overarching implementation partner. SCACAP processes customer applications, coordinates the program activities of the CAPs in DEC territory, and requests project cost reimbursement from DEC. DEC pays a fixed price per state WAP project completed at qualifying DEC customer’s homes, with the requirement that CAPs then use the utility funds to support future weatherization-related activities in additional homes. DEC can claim savings for all DEC customer projects.

### Learn more:

<https://www.duke-energy.com/home/products/income-qualified>

<https://www.scacap.org/energy-efficiency-programs.php>

## Utility-only Weatherization Programs

**Louisville Gas & Electric's (LG&E)** Weatherization, Conservation Advice and Recycling Energy (WeCARE) Program provides single-family low income customers with a home walk-through, including an inspection of the water heater and furnace to ensure there are no safety issues, and educational materials. Depending on the home's needs, LG&E provides a variety of energy efficiency measures and services, including air and duct sealing; attic and wall insulation; domestic hot water measures; heating and central air conditioning tune-ups; LEDs; programmable thermostats; high efficiency refrigerators; and/or high efficiency window air conditioners. The program does not include health and safety remediation. These services are at no cost to the customer and, to qualify, customers must have annual household incomes of less than 200% of the FPL.

### Learn more:

<https://lge-ku.com/wecare>

## Kits and other direct distribution efforts

**Alliant Energy Iowa** partnered with Green Iowa AmeriCorps (GIAC) to offer "community blitzes" with free home energy audits in two communities, as a supplement to their Low Income Weatherization program. However, after the COVID-19 pandemic struck, IPL and GIAC shifted to offering free Energy Saver Kits with low-cost measures, including LEDs; various domestic hot water measures; a furnace whistle; outlet and light switch insulators; caulking; and spray foam. The kit and website include a step-by-step installation guide.

### Learn more:

<https://www.greeniowaamericorps.org/energysaverkit>

## Neighborhood Canvassing

**Jacksonville Electric Authority's (JEA) Neighborhood Energy Efficiency (NEE) Program** is a partnership with the City of Jacksonville's Department of Housing and Neighborhoods to provide energy and water efficiency upgrades to low income customers. NEE staff visit qualifying neighborhoods to offer energy efficient lighting; low-flow showerheads and faucet aerators; toilet flappers; HVAC filters; and exterior door weather stripping and caulking. In cases of poor weatherization, customers receive attic insulation. Customers also receive tips on how to manage their electric and water usage. These services are at no cost to the customer and, to qualify, a neighborhood must have 50% or more residents living at or below 150% of the FPL. All residential customers in the neighborhood qualify.

Learn more:

[https://www.jea.com/about/community\\_impact/neighborhood\\_energy\\_efficiency\\_program](https://www.jea.com/about/community_impact/neighborhood_energy_efficiency_program)

DESC does not have a low income weatherization program that leverages WAP funding, but Dominion Energy (DESC's parent company) has recently committed to a \$15 million fund to partner with CAPs and deliver such a program in the future. Presently, however, the DESC Neighborhood Energy Efficiency Program (NEEP) does include offerings that belong to the other three categories.

DESC's "core" NEEP offering is a neighborhood canvassing design. DESC conducts door-to-door visits in neighborhoods where approximately half of the households have income levels equal to or less than 200% of the FPL. DESC partners with local community organizations and leaders to host a kickoff event prior to the visits. DESC offers customers a walkthrough of their home and direct installation of energy-saving measures; all at no cost to the customer. Depending on their needs, participants may receive LEDs; advanced power strips; HVAC filters; digital switch plate thermometers; and a variety of domestic hot water measures. Because DESC does electric demand-side management (DSM) only, customers must have electric water heating to receive the hot water measures and electric heating and/or cooling to receive HVAC filters. All residential customers in the neighborhood qualify.

DESC has a utility-only weatherization offering, but it is limited in scope, as it is only available for mobile/manufactured homes in qualifying NEEP neighborhoods. Customers receive the core NEEP home walk-throughs and direct install measures (see previous bullet), followed by various weatherization and HVAC measures. Most projects include air sealing, duct sealing, and a digital switch plate thermometer. Depending on needs, some projects also receive attic plug & fill insulation; bellyboard repair; reflective roof coating; programmable or Wi-fi-enabled thermostats; and/or a carbon monoxide monitor. To qualify, these customers must reside in neighborhoods where approximately half of the households have income levels equal to or less than 200% of the FPL.

DESC also has a kit/direct distribution offering. The free Low Income Kit includes LEDs and, in cases where electric water heating is confirmed or likely, kitchen faucet aerators. DESC offers the kit in two scenarios: 1) to customers who previously declined NEEP home visits (and thus the direct install measures); and 2) top customers in neighborhoods that meet NEEP criteria but are too small for inclusion in the program. This offering existed prior to the COVID-19 pandemic but DESC expanded it when in-person visits were on hold.

While not the dominant model, it is becoming increasingly common in the industry for utilities to implement a "portfolio" of low income offerings: combining multiple offerings into a comprehensive package of services

and for low income households. This is an approach that utilities, like Ameren Illinois Company (AIC), based on aggressive state policy or corporate goals to serve as many low income customers as possible. Fundamentally, the portfolio approach recognizes that the low income market is not homogenous. It allows the utility to address different levels of need; target specific customer groups (e.g., renters, elderly, manufacture homes, high energy users); and offer varying levels of time commitment and effort. In some cases, utilities approach the portfolio like a customer journey: it begins with a customer participating in an initial offering, such as a neighborhood sweep or receiving a kit, which then leads them into more involved offerings like weatherization upgrades. Below is a case study exemplifying the low income portfolio approach.

## A Portfolio Approach

**Ameren Illinois Company's (AIC)** Income Qualified Initiative is the utility's single largest residential program. It is made up of five distinct offerings: Home Efficiency Income Qualified (HEIQ), Community Action Agency (CAA) Channel, Smart Savers Channel, Safe and Virtual Energy Efficiency (SAVE) Kits, and Additional IQ Community Kits.

The Initiative provides weatherization and HVAC upgrades with and without WAP funding. The HEIQ and CAA channels both begin by providing no-cost energy audits and installation of energy-efficient direct install measures such as LEDs, showerheads, faucet aerators, advanced power strips, pipe insulation, and programmable/advanced thermostats at no cost to the customer. Following the audit, customers may also receive weatherization upgrades, such as air sealing and insulation improvements and HVAC replacements. The critical difference between the two channels is Illinois Home Weatherization Assistance Program (IHWAP; i.e., Illinois' version of WAP) participation. The HEIQ channel is a utility-only weatherization offering: program-qualified contractors serve moderate- and low income single-family customers who did not participate in the IHWAP; and moderate-income customers (201–300% of the FPL by household size) specifically have copays up to \$4,000 for HVAC and weatherization upgrades. The CAA channel, on the other hand, serves only low income single-family customers (200% of FPL or less) who are also participating in IHWAP at the same time. CAAs (which are highly similar organizations to CAPs) implement this offering on behalf of AIC and braid together utility and IHWAP funding to provide a comprehensive set of upgrades.

SAVE Kits are an offering within the HEIQ channel that AIC originally created to continue helping customers manage their energy costs and improve the comfort of their home while avoiding in-person contact during the pandemic. SAVE Kits provide energy and water saving products (e.g., LEDs, low flow showerheads, advanced power strips, and door sweeps) to customers while also acting as a “foot in the door” for hard to reach and underserved customers, as well as a catalyst for participation in other program offerings. AIC plans to continue offering SAVE Kits going forward.

Smart Savers provides smart thermostats at no-cost to customers in income-qualified zip codes. This offering, similar to SAVE Kits, also acts as an entry point into other energy efficiency offerings. Customers may choose to install the thermostat themselves and receive a \$25 incentive when thermostat activation is confirmed. Otherwise, they may choose to have a program-qualified contractor install the thermostat for them at no cost.

Finally, AIC provides variety of other kits and directly distributed measures to income-qualified customers, with the specific measures and targets changing every year based on specific opportunities that arise. For instance, in 2020, AIC handed out advanced power strips at foodbanks and sent air purifiers to low income senior households.

### Learn more:

HEIQ: <https://amerenillinoissavings.com/residential/instant-savers-assessment/>

IHWAP: <https://www2.illinois.gov/dceo/CommunityServices/HomeWeatherization/Pages/default.aspx>

SAVE Kits: <https://amerenillinoissavings.com/residential/save/>

Smart Savers: <https://ilsag.s3.amazonaws.com/AIC-Smart-Savers-Process-Evaluation-Memo-FINAL-2021-12-13.pdf>

## 10.2 Additional Design Considerations

The literature review revealed a number of other key considerations for low income program design.<sup>10</sup>

- **Develop /Fuel-Blind Offerings:** Many utilities include blind-fuel offerings to address all possible energy end uses in low income homes. When a utility provides only one fuel type, or does demand-side management (DSM) for only one fuel type, this is generally done in one of two ways: 1) by developing a program in conjunction with another utility (e.g., a gas-only utility in the same area) or by partnering with a CAP or CAA to administer the program and combine utility funding and federal WAP funding to cover the measures the utility cannot fund.<sup>11</sup> DESC is an electric and gas utility but currently only does electric DSM. DESC is currently in the process of developing gas DSM programs, which will create opportunities for additional offerings in the coming years.
- **Remediate Health and Safety Issues as Much as Possible:** A longstanding problem for low income weatherization programs are deferral of projects whose homes require extensive repairs or pest, mildew, and mold remediation prior to implementing weatherization and HVAC upgrades. In many cases, these homes cannot receive program service until the issues are addressed, but the costs to address them can be beyond what a utility can cover within the rules around use of DSM funds and/or cost-effectiveness constraints. Some utilities go as far as they can within the limits of their funding: they allow for small and expedient repairs and remediation in special circumstances, with permission from the program manager. DESC takes this approach with the manufactured home weatherization pilot.
- **Align Eligibility Criteria:** About half of the utilities the team reviewed streamline their enrollment by aligning their income eligibility requirements with other income-qualified programs (e.g., WAP and LIHEAP).<sup>12</sup> Especially when combined with a community partnership strategy, aligning income eligibility criteria with other programs may reduce administrative costs for partners and, most critically, enable customers to enroll in multiple program and services at once; giving them access to a more holistic support system for their energy and non-energy-related needs. DESC recently updated the qualification criteria for NEEP from 150% of the FPL to 200%, which aligns with LIHEAP and WAP qualification criteria for weatherization services.
- **Make Participation Simple and Convenient:** While it is a key to success for most energy efficiency programs, make participation as easy as possible for the customer is especially important for low income customers, who may work multiple jobs, long hours, or simply not have spare time to participate due to the lack of financial luxuries like childcare. A strategy some utilities have used to simplify the participation process is maintaining a single point of contact for each customer. This approach can 1) reduce confusion about the offerings and options available; 2) clarify where the customer should go with questions; and 3) limit the time and effort the customer spends in participating overall.<sup>13</sup> Based on past evaluation results, participants are generally highly satisfied with NEEP. However, the program continues to struggle in some neighborhoods with getting customers interested in the time commitment for a home visit. Should DESC adopt even more time-intensive

<sup>10</sup> Drehobl, Ariel, and Kate Tanabe. 2019. "Extending the Benefits of Nonresidential Energy Efficiency to Low income Communities." ACEEE. November, 2019.

<sup>11</sup> Drehobl, Ariel, and Fernando Castro-Alvarez. 2017. "Low income Energy Efficiency Programs: A Baseline Assessment of Programs Serving the 51 Largest Cities." ACEEE. November 3, 2017.

<sup>12</sup> Drehobl, Ariel, and Fernando Castro-Alvarez. 2017. "Low income Energy Efficiency Programs: A Baseline Assessment of Programs Serving the 51 Largest Cities." ACEEE. November 3, 2017.

<sup>13</sup> Drehobl, Ariel, and Kate Tanabe. 2019. "Extending the Benefits of Nonresidential Energy Efficiency to Low income Communities." ACEEE. November, 2019.

offerings, such as low income weatherization, it will need to focus on maintaining a simple and convenient customer experience to reduce barriers to participation.

## 10.3 Conclusions

### 10.3.1 Alternative Funding Strategies

Many utilities leverage additional federal, state, and utility funding sources to address non-energy-related needs and generally increase the amount of funding that may be allocated to an individual customer. Utilities often do not qualify for state and federal funding sources on their own. As such, they access this funding indirectly through partnerships with local governments or other community-based organizations (CBOs) who do qualify; ideally with those who share common goals with the program. Once these partnerships are established, the community partner will also be able to package the program with the other support services (e.g., social services, LIHEAP, other non-energy-related programs) they provide to residents. Some utilities may also combine energy efficiency funding with other internal funding sources that are earmarked for related purposes, such as community development, economic development, or philanthropic funds. DESC's low income offerings do not leverage a partnership with a CBO or funding from other departments within DESC. In the literature review, the team also looked at other types of funding, in addition to utility DSM dollars, that other utilities leverage to support low income programs. More detail on alternative funding strategies is below.

#### Leveraging Funds through Community Partnerships

The simplest and most common way for utilities to increase their program funding is by partnering with CAP agencies for program implementation. By utilizing CAPs as program implementers, utilities can leverage DOE WAP funding alongside their own DSM funds, allowing them to accommodate more participation and to expand upon the type and number of measures they are able to offer. For the current 2022 program year, the Biden Administration has announced that, country wide, WAP funding will equate to \$3.5 billion, creating many more opportunities for weatherization upgrades.<sup>14</sup>

In South Carolina, leveraging this massive influx of funding would likely require a partnership with SCACAP, who oversees the network of local CAP agencies that implement WAP projects. In the community leader interviews, SCACAP staff mentioned that, while rules vary state-to-state, the Department of Energy (DOE) generally has regulations in place that prevents utilities from funding projects with both utility DSM and WAP dollars; doing so would require the utility to reimburse the WAP portions of the costs. Through a CAP partnership, however, a utility is able to use a CAP implementer as a gateway for these funds; an approach DEC has used for their Low income Weatherization Program (see the DEC case study in section 10.1).

According to SCACAP staff, in order to maximize both utility and WAP funding through CAP partnerships, it is essential for utilities to be flexible in terms of measure offerings and the proportion of costs they are willing to cover with program allocated funds. Flexibility in measure offerings allows CAP agencies to not only implement measures that meet DOE requirements and are eligible to be covered by WAP funding, but also to make additional improvements and replacements in the home using the utility's program budget. This approach is an example of how leveraging both forms of funding can maximize the benefits delivered to the customer.

#### Other Federal Funding for Energy Efficiency

<sup>14</sup>"Bipartisan Infrastructure Investment and Jobs Act Summary." 2021.  
<https://www.cantwell.senate.gov/imo/media/doc/Infrastructure%20Investment%20and%20Jobs%20Act%20-%20Section%20by%20Section%20Summary.pdf>.

- President Biden's Bipartisan Infrastructure Investment and Jobs Act presents another potential opportunity for additional funding in the near future.<sup>15</sup> In addition to WAP funding, the recently passed bill includes many awards targeted at energy efficiency and energy related pathways, including the following:
- \$40 million (2022-2026): Grants for eligible states, with the purpose of training personnel to conduct energy audits or surveys of commercial and residential buildings;
- \$250 million (2022): A revolving loan fund capitalization grant program within the State Energy Program with the purpose of conducting commercial energy audits, residential energy audits, or energy upgrades or retrofits; and
- \$550 million (2022): Energy Efficiency and Conservation Block Grant (CBG) Program with purpose of funding programs that finance energy efficiency and other clean energy capital investments, projects, loan programs, and performance contracting programs

Although it is unclear how exactly these dollars will be distributed across various entities at this time, as a utility, DESC will likely not be directly eligible for most, if any, of this funding on their own. This again highlights the importance of establishing partnerships with state/local governments or CBOs who qualify for these funds. Given the focus on energy efficiency, these partnerships may be mutually beneficial: providing DESC access to additional funding and providing the partner with a means to achieve their organizational objectives related to energy upgrades (and thus improving their chances of receiving these funds).

### 10.3.2 Community Engagement Strategies

In addition to reviewing program designs and funding strategies, another core objective of the low income deep dive was to identify potential community engagement strategies that DESC could use to increase participation in NEEP. By their nature, there is no one-size-fits all solution and strategies should be tailored to specific communities. However, the literature review and interviews with community leaders in Charleston, Aiken, and Saluda revealed a number of cross-cutting best practices.

#### Establish Presence and Recognition in the Community

All community leaders in each of the three communities discussed the importance of DESC staff's involvement and presence within their community in order to build relationships and trust among the low income population.

"You have to build relationships and trust with people before you come into their neighborhood saying, 'Hey, I want to help you,' because that's a setup for not having strong participation [in] low income neighborhoods."

(Charleston leader)

Leaders from the smaller or more rural communities, Aiken and Saluda, particularly emphasized the need for face-to-face interactions and personalization in communication. Leaders noted the "close knit" relationships that trust is built upon, and how lack of recognition is likely to result in skepticism and unresponsiveness toward program offerings. One leader the team spoke with heads an active nonprofit agency in Saluda. The leader explained that when they first entered the trailer parks in the community, where a vast majority of Spanish speaking residents live, to hand out presents at Christmas, residents initially refused to open their

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<sup>15</sup> *ibid*

doors. However, once they established stronger reputations and relationships in the community, this effort transformed into successful annual event.

“That was a learning curve for us to realize they're going to be skeptical, but now they know us. And when we go into the community, they're like...this is Ms. [Last Name], she comes to our school and we know her...So if guys are in a white work truck that says Dominion and they knock on the door and even if they're holding free light bulbs, they're probably not going to have somebody answer the door.” (Saluda leader)

### Who, What, Where? Use a Customized Approach

The low income population is comprised of many diverse groups who have varying needs, interests, lifestyles, etc. (e.g., single parent household versus elderly couples on fixed income), which are important details when considering where customers are looking for their information. Leaders emphasized the need to use a mixture of ME&O tactics, and in some cases a mixture of languages, depending on who you are trying to reach. Community leaders the team spoke with also suggested that segmenting the market on characteristics beyond income would enable program implementers to more effectively get program marketing materials into the hands of the target population. Acknowledging these differences can also help inform utilities on what upgrades or improvements may be of highest priority and most beneficial to certain customer groups (e.g., renter vs. homeowner).<sup>16</sup> For instance, using the a “portfolio” program design (see Section 10.1), utilities are able to not only provide a wide variety of offerings to their customers, but they are able to target these offerings and outreach efforts to specific customer segments who may benefit most from participation.

#### GENERATIONAL DIVIDE

Across the leader interviews, various opinions surfaced regarding the most effective modes of communication in reaching low income customers. In general, leaders recommended a mixture of tactics depending on who the target is. As an example, some leaders highlighted an age divide in terms of communication preferences.

Some leaders said that traditional forms of direct marketing (e.g., mail, email, bill inserts), may be more effective in reaching older populations who are less “tech savvy”, whereas younger populations may be more receptive to newer forms, such as text and app notifications.

*“The younger population, low income household, they use the [smart phone] app more. But when you talk about the older population, no, they're not familiar with the app and they're not interested.”*

*(Charleston leader)*

Conversely, some leaders suggested that social media and other types of indirect marketing, (e.g., radio, TV) were effective strategies. However, different social media platforms appeal to different age groups.

*“Depending on who your audience is, [use] some type of social media advertisement based on the age demographic of who you're trying to reach. If it's a program for people who own their own homes and people in their 40s or 50s, it would be Facebook. “*

*(Aiken leader)*

<sup>16</sup> Gilleo, Annie, Seth Nowak, and Ariel Dreihobl. 2017. “Making a Difference: Strategies for Successful Low income Energy Efficiency Programs.” ACEEE. October, 2017.

## IN-LANGUAGE ME&O IN SALUDA: SPANISH AND MORE

All leaders we spoke with from the Saluda community acknowledged the large Hispanic population living in the region, many with limited to no English-speaking proficiency, requiring the availability of Spanish-translated program materials. One leader also noted the increasing Guatemalan population that is moving into the community, who speak a specific tribal dialect that there is no translator in the community for. This presents an increasingly difficult scenario for conducting outreach to these residents. In the interview, the leader indicated one church in the town with a pastor who is originally from the same village most of Saluda's Guatemalan residents originate from. This pastor has helped with spreading awareness of other resources available to residents within the community and was suggested as a key connection for conducting marketing, education, and outreach to this growing minority population.

*"A lot of times the school will try to solve that problem by sending documents home in English and Spanish, but I'd say 90% of the Guatemala population we work with don't read and write in English or in Spanish and the primary dialect among that people is Mam. It's not even true Spanish, it's a tribal dialect and we don't have any translators for that language."*  
(Saluda leader)

## Highlight Program Benefits Through Testimonials

Providing customers with case studies that demonstrate program success is a tried-and-true method for attracting new customers and spreading awareness of energy efficiency program opportunities.<sup>17</sup> A key to success is ensuring the success stories are relatable to the target customer. For example, when targeting a low income customer who rents a small home, it would be ideal to share a story where the participant was also a renter in a similarly size home, as this will improve the credibility of the potential energy, monetary, and/or health and safety benefits the customer can expect to see as a result of participating in the program.

Community leaders the team spoke with supported this outreach practice; with many emphasizing that, without some sort of proof or case study example, low income customers will remain skeptical or uneasy about participating. Most low income program offerings are delivered at no cost to the customer, which for many sounds like the offer is "too good to be true". Another leader mentioned that providing more specific "numbers" (i.e., estimated energy or costs savings) may improve the attractiveness of the program:

"I also [think] coming out with actual numbers [is effective], like, 'Hey, Dominion's coming. They'll do this, they'll do that. And here's how much it can save you and it could really help your utility bill.'...Numbers are definitely something people will want to see. I know if this program was offered to me, if I don't see numbers, then I don't know how it's actually going to benefit me."

(Charleston leader)

<sup>17</sup> 2014. "Effective Marketing and Outreach Strategies for Multifamily Energy Efficiency Programs." ACEEE. May, 2014. <https://www.aceee.org/sites/default/files/pdf/marketing-strategies-multifamily.pdf>.

### 10.3.3 Community Partnerships

The literature review revealed a few best practices for utilities to establish and maintain successful partnerships with community organizations.

#### Select Partners Who Share Common Goals with the Utility

Developing partnerships with community organizations who share common goals with the program is an ideal start to a strong, successful relationship. By seeking out organization whose mission is consistent with the program, utilities can identify partners who will bring passion to implementation efforts and promote a “quid pro quo” effect while helping the organization reach their own personal goals simultaneously.<sup>18</sup> Appendix G Utilities should also seek out organizations that already serve hard-to-reach customers groups that the utility would also like to target.<sup>19</sup> This enables the utility to meet the customer where they are already going for support and leverage those credible messengers. This strategy is especially important when targeting low income customers who generally have less awareness of programs or limited time or means to research energy efficiency options available to them. One of the community leader interviews emphasized this point:

“I think with what you're doing in terms of partnering with an agency to go into communities, definitely choosing a well-trusted organization that is heavily connected and has a lot of influence on communities... you're going to have more people who are interested because they already have an established relationship that they trust with the organization or with people there...You would have a better success rate with a really well-known, well-influenced organization.”

(Charleston leader)

#### Establish Realistic Expectations

Clear expectations regarding the partner’s role in a program should be communicated early on by the utility to ensure clarity amongst all parties. When seeking out potential partners, it is important to consider what resources, in addition to funding, the organization will be able to devote to the program.<sup>20</sup> Appendix G For example, discuss with the partner whether their organization has sufficient staffing with the expertise to support program implementation efforts; and if they can devote both staff, time, and funding to these efforts for the expected duration of the partnership. These are critical questions utilities must ask early on to establish realistic expectations around the extent of support the organization will be able to provide. As one leader described it:

“[Our organization] has the human capital, the people, we have the facility, but we may not have the money or the expertise to house the programs. So, if there was a partner where someone could handle the money and provide the expertise, we could provide the staffing and the location.”

(Aiken leader)

#### Develop Customizable Marketing Materials

<sup>18</sup> Cluett, Rachel, Jennifer Amann, and Sodavy Ou. 2016. “Building Better Energy Efficiency Program for Low-Income Households.” ACEEE. March, 2016.

<sup>19</sup> Bean, Meghan B., and Marjorie McRae. 2016. “Power to the People: Using Community-Based Approaches to Deliver Efficiency and Sustainability to Hard-to-Reach Populations.” ACEEE Summer Study on Energy Efficiency in Buildings. 2016.

<sup>20</sup> Dreobl, Ariel, and Kate Tanabe. 2019. “Extending the Benefits of Nonresidential Energy Efficiency to Low-Income Communities.” ACEEE. November, 2019.

When partnering with a community organization as a program implementer, utilities should develop and provide marketing materials, but leave room for customization. Local organizations are knowledgeable about the community they serve in general, as well as the specific customer population the program is targeting, generally making them more adept at creating personalized and effective marketing and outreach materials. Utilities should always leave a line of communication open to partners while they are revising materials, and throughout the duration of the program, to allow them access to expert resources if they have questions about the program design.<sup>21</sup> Appendix G

### Monitor and Reduce Partners' Administrative Costs

In general, frequent and intentional communication with partners can help to ensure they have all forms of support they may need. Utilities should pay particularly close attention to partners' administration costs and consider providing some form of funding to cover these costs. For example, the DOE only covers administrative costs for the portion of measures that receive WAP funding.<sup>22</sup> While it is not required for a utility to cover these costs, it can be advantageous to provide CAPs with assistance to ensure they can maximize the use of utility and WAP funds for direct services to residents.

### Community-specific Partnership Opportunities

Leaders provided recommendations for several partnership opportunities in Charleston, Aiken, and Saluda. The Study Team provide the full list of organizations and brief descriptions of their services in Appendix G.

<sup>21</sup> Cluett, Rachel, Jennifer Amann, and Sodavy Ou. 2016. "Building Better Energy Efficiency Program for Low-Income Households." ACEEE. March, 2016.

<sup>22</sup> Opinion Dynamics. "AIC Income Qualified Initiative: Braided Funding Best Practices Research Results." March 28, 2019.

## 11. Midstream and Upstream Model Potential

Energy efficiency programs can be classified as downstream, midstream, and upstream market interventions. Downstream programs target the customer with incentives directly, while midstream and upstream programs target actors earlier in the supply chain. Upstream and midstream program efforts generally incentivize distributors to stock high efficiency equipment and manufacturers to develop high efficiency products. Midstream and upstream programs have the potential to achieve greater savings than traditional downstream programs because they intervene higher up in the supply chain, which generally enables these programs to reach a larger share of the market than traditional programs.

The definitions of midstream and upstream vary across programs. This variation in terminology can likely be explained by the evolution of the use of these terms in the industry as the term “midstream” has become more nuanced over time and is commonly used to refer to programs that incentivize distributors or sometimes contractors/retailers directly, while upstream programs can refer to incentivizing both distributors and manufacturers. Here, the team refers to programs that target distributors as midstream programs, as this is congruent with the current industry definition of midstream.

Figure 25. High efficiency market with midstream/upstream intervention

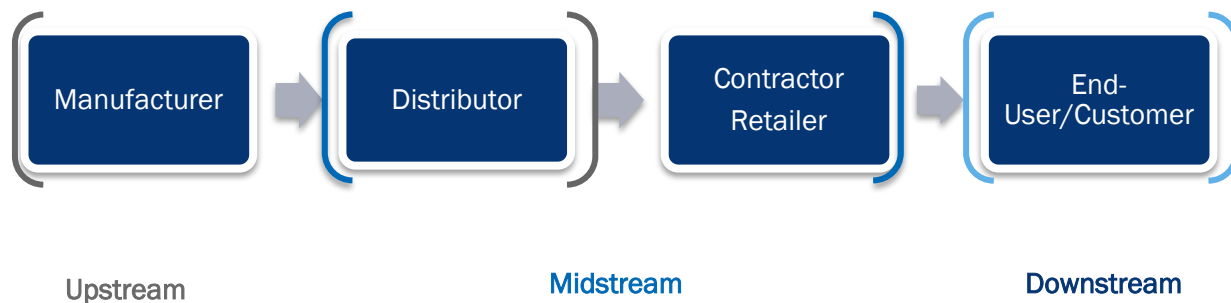
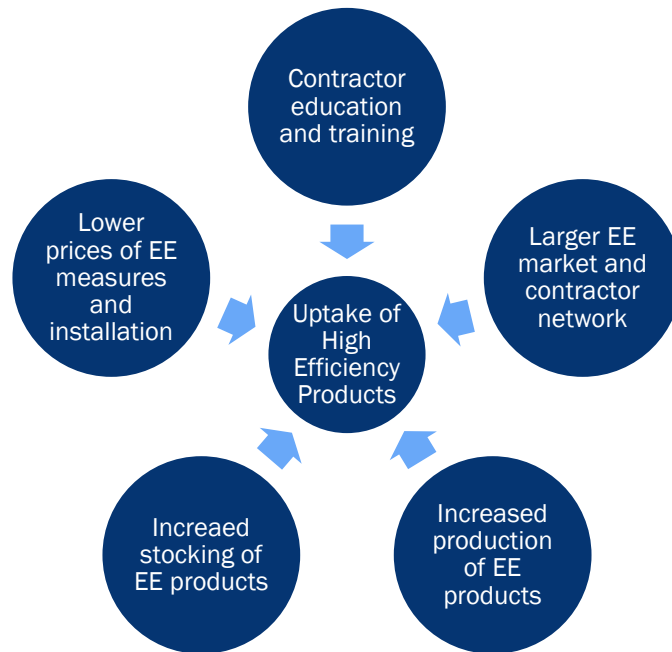


Figure 26 below displays the common behavior changes implemented by target actors (mostly focused on distributors and manufacturers) after program implementation is put into place. Incentives, discounts, and rebates are the main triggers that lead these target actors to execute these activities, thus transforming the energy equipment market and feeding into the ultimate goal of fostering the uptake of EE measures in residential settings, as well as producing energy savings.

Figure 26. Post-incentive activities of target actors



The study team compiled a summary of the known performance to-date of midstream programs throughout the country. The information provided in this chapter is based on a literature review of over a dozen reports related to residential midstream programs (Table 85).

Table 85. Residential reports included in literature review

Author(s)	Title	Sponsor	Year
Demand Side Analytics, Apex Analytics	Retail and Distributor Lighting Products Impact Evaluation	Efficiency Maine	2021
Opinion Dynamics	California Heat Pump Market Characterization and Baseline Study	California Public Utility Commission (CPUC)	2021
Cadmus	Report to Verify Efficiency Vermont 2019 Savings Claim	Vermont Department of Public Service	2020
Brysen Daughton, E Source	Upstream Program Designs for Different DSM Measures	E Source	2019
NMR Group	The Great Migration:	NMR Group	2019

Author(s)	Title	Sponsor	Year
	Moving Energy Efficiency Programs to Midstream		
Apex Analytics	Retail Product Portfolio Evaluation - Final Report	Northwest Energy Efficiency Alliance (NEEA)	2019
EMI Consulting	Pacific Gas & Electric ENERGY STAR® Retail Products Platform (ESRPP) Program Pilot Early Evaluation: Final Report	Pacific Gas & Electric (PG&E)	2019
Eversource	Comments on the CT Upstream HVAC and Water Heater Process Evaluation and Heat Pump Hot Water Heater Upstream Program	Eversource Energy	2018
Cadmus and Sawtooth Analytics	Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report 6	NEEA	2018
Merson, H., et al	Five Years and Beyond with Supply Chain Engagement: What's Next with Upstream and Midstream?	VEIC and Energy Solutions	2018
West Hill Energy and Computing, EMI Consulting, Lexicon	CT Upstream HVAC and Water Heater Process Evaluation and Heat Pump Hot Water Heater	Energize Connecticut	2017

Author(s)	Title	Sponsor	Year
Energy Consulting	Upstream Program		
Maureen Quaid and Howard Gellar	Upstream Utility Incentive Programs: Experience and Lessons Learned	SWEEP	2014

## 11.1 Program Model Performance-To-Date

Program Administrators (PAs) across the country have been deploying midstream programs to deliver a variety of different measures to customers for over 20 years. Table 86 provides some examples of the different residential measure types that PAs have commonly delivered through residential midstream program models. Midstream programs helped to successfully transform the market for lighting measures and consumer electronics. As such, there are currently limited market opportunities to offer many of the measures listed in Table 86 including LEDs, CFLs, TVs, and computers.<sup>23</sup>

Table 86. Summary of midstream measure offerings

Residential measure type	Program administrators that deliver the measure type through a midstream program model
Residential	
Lighting (CFLs and LEDs)	Many Program Administrators have executed this and already transformed the market.
Electronics and appliances (e.g. ENERGY STAR® TVs, personal computers, and monitors)	NEEA, PG&E, SoCal Edison, SMUD, Mass Save, Efficiency VT, NYSEDA and others
HVAC (e.g. ductless heat pumps, and heat pump water heaters)	NEEA, CA Statewide PAs

Source: (Quaid and Gellar, 2014)

The Study Team examined evaluation results from several of the most current midstream programs to further understand the measure offerings delivered and the adoption of each measure type (Table 87). It is important to recognize there are limitations to using past evaluation results to inform the selection of new midstream program measure offerings. The evaluation results currently available cover program results through 2021 but the market for efficient products is constantly evolving and changing. It is vital to be cognizant of the market shifts in response to Covid-19 and current supply chain issues when analyzing historic midstream initiatives to guide future potential programs.

Evaluation results demonstrate that multiple programs successfully delivered HVAC and lighting measures to customers through midstream models. Results available to the public to-date show that midstream models

<sup>23</sup> Quaid and Gellar, 2014

tend to have large participation numbers and low operating costs, however there is lack of information in the marketplace around free-ridership especially as it relates to residential HVAC measures. Many PAs are currently in the midst of conducting free-ridership for these programs and we expect that information to be available to the marketplace in 2023.

Table 87. Midstream program measure offerings and performance

Program name	Measures offered	Measure adoption results
Efficiency Maine Retail and Distributor Lighting Products	Specialty LED Long Life/Short Life, LED Specialty Bulb Reflector Long/Short Life, etc.)	Modelled net-to-gross ratio of 68%, including both free-ridership and spillover
Efficiency Vermont Retail Efficient Product Services	LED and HVAC	Despite lack of information regarding costs, free ridership, and incentive structure, the Residential Upstream program with Smartlight (LED) and HVAC components achieved 100% realization rates.
NEEA Retail Products	Residential retail products: refrigerator, clothes washers/dryers, freezers, room air cleaners, soundbars, room air conditioner, Ultra-HD televisions	Midstream incentives alone are likely to drive uptake of efficient products only under specific market conditions; other strategies are necessary for many products.
Pacific Gas & Electric ENERGY STAR® Retail Products Platform (ESRPP) Program Pilot	Residential retail products: refrigerator, clothes washers/dryers, freezers, room air cleaners, soundbars, room air conditioner, Ultra-HD televisions	288 participating retailers in pilot phase alone.
NEEA Ductless Heat Pump Initiative	Ductless Heat Pumps (DHP)	Since 2008, an estimated 162,333 DHPs have been installed in the region, with 68,253 (42%) installed in NEEA's target markets. Total annual DHP installations have increased each year since the Initiative started in 2008 (Cadmus, 2018).
NEEA Heat Pump Water Heater Initiative	Heat pump hot water heaters	The number of heat pumps sold in the Northwest increased from 6,000 in 2016 to 12,400+ in 2017, the first year of the Initiative (Merson et al. 2018).
Connecticut Residential Upstream HVAC and Water Heating Program	High efficiency furnace, high efficiency boiler, ECM boiler circulating pumps, furnace fan, heat pump water heater	Boilers and circulating pumps comprised the highest number of rebates, followed by furnaces. the number of rebates issued increased from the first to the second year of the program for both measures. Heat pump hot water heaters had substantially lower adoption (West Hill, 2017).
ComEd Midstream Incentives Program	LED lamps, LED fixtures, LED exit signs, linear fluorescents, and battery chargers	LED lamps made up approximately 84% of the total program verified net electric savings (211,210 MWh)

Based on the literature review, lighting, retail products, and HVAC equipment have been the primary residential categories for upstream and midstream products. Following the distributor interviews explained below, the residential new construction lighting market may have already transformed to efficient LEDs, but opportunities may still in existing housing stock, especially with lighting controls. Residential HVAC measures with the most promise for residential midstream models are:

- LED Lighting Controls
- Heat pumps (heat pump water heaters and other heat pump-related technologies)
- Residential Retail Products (including major appliances and home electronics)

Heat pumps show strong market potential across the US and this measure has proven to be a good fit for the residential midstream program model in some other jurisdictions<sup>24</sup> such as California.<sup>25</sup> However, a primary source of heating in DESC homes are air source heat pumps (48%) so the potential would vary in the DESC service territory. In DESC homes, the penetration of heat pump water heaters is less than 1%, potentially providing opportunities in water heating for heat pumps. Controls mentioned below in conversations with distributors, which would include lighting controls and also advanced thermostats and may be an additional area of opportunity.

## 11.2 Midstream Market Receptivity to Program Model

The Study Team interviewed distributors in DESC service territory, looking to understand awareness of midstream programs, involvement in this type of program delivery model, and receptivity to participating in a DESC-sponsored midstream program. Interviewees included both lighting and HVAC equipment distributors serving a combination of residential and non-residential buildings. A key takeaway from these interviews is that HVAC distributors were aware of midstream programs and thought favorably of them in general. While HVAC distributors did identify a number of important considerations for a program, they responded positively to the possibility of midstream program design.

The Study Team also held a workshop with seven HVAC and plumbing contractors who serve DESC residential customers and discussed the same topics. Overall, the residential contractor workshop attendees were knowledgeable of Dominion's residential programs and comfortable with most of the incremental cost assumptions for given incentive levels (except for the duct replacement estimate of \$2,500 which they felt was much too low). Although contractors felt that some of the expanded incentives for new and existing programs were sufficient to move the needle towards increased EE equipment sales, they raised concerns with incentives that were not high enough to cover the marginal cost of labor to implement (specifically with regards to HVAC tune-ups and duct sealing/replacement). All contractors agreed that under a midstream program delivery channel, equipment distributors would likely not pass rebates along to customers or contractors.

### 11.2.1 Disposition and Characterization

The Study Team began with a list of forty-three distributors in the lighting, HVAC, and food service distribution spaces, attempting, the team completed nine interviews representing eight distributors. Of the remaining thirty-two contacts, fifteen did not respond to attempts to contact, eight refused to be interviewed, and nine were deemed invalid for various reasons (duplicate, not available, or not otherwise eligible. Six of the eight

<sup>24</sup> Merson et al., 2018

<sup>25</sup> Guidehouse, 2021

distributors serve residential customers and two only serve non-residential (see Table 88). These distributors serve customers throughout DESC territory, with several distributors covering all of the U.S. (see Table 89)

Table 88. Completed Interview Type by Equipment and Sector

Equipment	Residential only	Non-residential only	Both res & non-res
Lighting or “Electric”	0	2	4
HVAC	0	0	2
Food Service	0	0	0

Table 89 Individual Responding Distributor Sector, Equipment, and Geographic Area

Distributor	Sector	Equipment	Geographic Area
1*	Both	Electric	Specific to interview, 25-30 counties surrounding Augusta, GA, including 10 in S.C. around Columbia
2	Both	HVAC	Tri-County surrounding Charleston
3	Both	Electric	S.C. Coast down to Savannah, GA
4	C&I	Electric	All U.S.
5	Both	HVAC	Lower 1/3 of S.C.
6*	C&I	Electric	All of S.C.
7	Both	Electric	All of Southeast, focus surrounding Savannah
8	Both	Electric	All S.C., focus on Greater Columbia

\*Interviewees specifically identified that company is nationwide but referred to just their own territory for interview. Other organization may also have larger footprint, but interviewee referred to own area of responsibility.

The workshop with seven contractors ran similar to a focus group, with a moderator and a set agenda of topics for discussion. Seven contractors attended the first workshop, which included residential HVAC and plumbing contractors. All attendees of the residential contractor workshop service the Columbia area, some service Aiken, and one services Charleston. The discussion topics covered by the residential contractor workshop include: Water Heating, HVAC Equipment, Duct Repair & Replacement, Tune-Ups, Small Business Non-Lighting Measures, Midstream Delivery Channel Program Concept, and Miscellaneous Items.

### 11.2.2 Program Awareness and Interest

Of the nine professionals interviewed, almost all (8 of 9) were aware of midstream programs. They had heard of the concept before or could identify that the incentive goes to the retailer, distributor, or manufacturer instead of directly to a customer. All respondents were interested in the concept and indicated strong interest in learning more about any specific program that may be offered in their territories by DESC. Overall, the seven residential contractor workshop attendees were aware and knowledgeable of Dominion’s current residential programs.

## 11.2.3 Equipment Opportunities

### Electrical Distributors

Overall, electric distributors expressed mixed opinions about the opportunity for lighting in the residential sector. Some electrical distributors indicated that the entire market for lighting had completely transformed to LED, there was no longer any customer demand for other options. Other electrical distributors identified that there was still a market – upon further investigation it was identified that the distinction exists between supplying existing fixtures and new construction. New construction is not looking for anything other than LED fixtures, outside of specialty lighting products whereas it was indicated that there may still be opportunity in the market for retrofitting existing lighting. In summary, any lighting opportunities that may exist are in a market that is already largely transformed, where new construction selects LED options as the default, and any remaining opportunity for lamps is in retrofit applications. However, several distributors did identify lighting controls as an area where they are seeing more growth and interest. It was clarified by one distributor that the area where they see the market turning now is in occupancy sensors, and not more fully automated or centrally controlled systems, indicating that there may still exist opportunity with advanced lighting controls.

### HVAC Distributors

HVAC distributors identified high efficiency equipment as generally consisting of units rated 16 SEER or higher, with as much as 40% of sales falling into this category, with the cost difference between a generic 14 SEER and a 16 SEER estimated at \$1,500-\$2,000. One distributor did note that while price is a consideration, so is the attitude of contractors, stating “...because it's got a lot of bells and whistles in it, they're scared of it, especially your older contractors.” This point supported within numerous studies within the literature examined, that any program offered must have a strong engagement element regardless of incentives.

Both distributors interviewed expressed moderate to strong interest in a midstream program for efficient HVAC equipment, but with a common set of reservations that can be summarized as hassle. Interviewees identified that a barrier for them would be if the program required too much of them. Examples offered included complicated incentive rules with lots of variation from product to product, excessive application paperwork, rebate delays and potential rebate refusals. In summary, any program that collaborates with distributors should be made to be as effortless as possible for distributors.

### HVAC Contractors

Six of the seven contractors who participated in the workshop sell and install residential HVAC equipment. The goal of the HVAC discussion was to gain feedback on new and existing program and measures related to HVAC equipment, barriers to adoption and industry standard practices related to such measures. Despite some objections to incentive calculation and EE qualification (detailed below), contractors expressed the importance of rebates coming directly from the utility since it limited higher-cost EE products to customers and convinced them that the additional cost was in their best interest (and not just a contractor upselling them to a more expensive unit to net a higher profit). All HVAC contractors were also enthusiastic about a proposal to have the HEC program generate referrals to contractors.

Workshop attendees were asked to verify the incremental cost assumptions underpinning the proposed incentives; specifically, the additional cost of to purchase a rebate-eligible HVAC measure relative to the cost of a SEER 14 equipment. While all contractors agreed with the incremental cost assumptions and felt that the proposed incentive to move from SEER 14 to SEER 15 and 16 were enough to encourage the sale of the higher efficiency HVAC systems, all agreed that the marginal increase in the incentives to move to the higher levels of efficiency did not align to the incremental cost. For example, one contractor said that if a customer could

get a rebate of approximately \$500 to go from a SEER 14 to SEER 16 unit, the additional ~\$125 incentive to instead purchase a SEER 17 did not align to the additional \$800 (on average) a customer would need to spend for such a unit.

We also asked HVAC contractors to provide input on the appropriate incentives for a new rebate for customer's moving from electric resistance heat to air source heat pumps (ASHP). While some of the HVAC contractors felt that the market for such a rebate had been fully saturated, others felt that there was still an opportunity for such incentives with lower income and mobile home customers. However, given the increased price sensitivity of this customer segment, the rebates would need to be substantial to encourage customers to purchase EE alternatives. One contractor suggested up to \$500 would need to be offered for such an upgrade and most attendees nodded in agreement that this incentive amount would cover most of the incremental cost.

Contractors also noted that HVAC incentives for units at or above SEER 18 often ignore the necessary upgrades to ductwork required so that the air distribution system can handle the increased tonnage of the new equipment. The lack of ductwork upgrades for such units often leads to system leakage and reduced efficiency. All HVAC contractors emphasized the importance of bundling requirements for such upgrades. Without such requirements, customers will forgo the ductwork upgrades because they can still receive the rebate for the HVAC system. This was noted as a particular problem with new construction homes where the ducts are standard SEER 14 size, but the systems are SEER 18 (Thereby allowing builders to market homes as more efficient without paying for full duct upgrades).

### Duct Repair & Replacement Contractors

Six of the seven attendees at the workshop perform ductwork replacement and upgrades, and all except for one have completed duct rebates under the current incentive structure. All ductwork contractors agreed that it rarely made sense to perform ductwork repairs instead of upgrades (with or without the incentives), for several reasons. First, the paperwork and testing required to qualify for such rebates is expensive and requires skilled technicians that are better utilized on higher paying jobs.

*"One thing I wanted to say is that the huge change in our industry from when I started to today is now our service technicians are much more valuable than our customers...see, we need somebody smart enough to work on sophisticated equipment and dumb enough to go in an attic and crawl under a house"*

For example, replacing ductwork or air sealing existing ductwork required pre and post duct blaster tests. Such tests required two additional visits from an HVAC technicians and cost roughly \$300-400 to complete (so \$600 - \$800 total). Even under the proposed expanded incentives of \$300 for ductwork sealing and ductwork replacement are cancelled out by the cost of such tests.

Additionally, most of the contractors said that most of their duct-related work happens on projects where they are installing a new system. Often times such systems have increased tonnage or capacity that the existing ducts cannot support, and full replacement makes the most sense in these circumstances. Still, customers can decline the additional duct upgrade (and they often do). Overall, most contractors felt that a customer and contractor rebate would be necessary to encourage such a program, with a portion of the contractor rebate going directly to the technician (to encourage higher skilled technicians to pursue such jobs relative to higher-paying ones). Also, given the sealing and insulation that goes into a full duct replacement, all contractors felt that a \$600 rebate (the combined cost of the proposed air sealing and insulation ductwork upgrade rebates) should be offered for full duct replacements.

When asked whether \$2,500 was a good estimate for the average cost of a duct replacements, all of the contractors agreed that this was estimate was too low but they could not offer a different estimate.

### HVAC Tune-Ups

Six of the seven workshop attendees offer HVAC maintenance, to include tune-ups. The goal of the discussion was to gain feedback on a proposed HVAC tune-up program, including what such a program would entail, the incentives offered by this program and potential barriers to adoption. Most of the contractor's felt that the iManifold testing gauges were either too complex or did not perform as expected. Additionally, all contractors said they stopped offering refrigerant refills as part of their maintenance contracts as it was merely putting off paying for a problem that would become costlier to fix in the future.

Although all contractor's verified the \$175 cost assumption for HVAC tune-ups, the proposed incentive of \$44 was debated due to several barriers to adoption. Specifically, contractors noted several challenges with implementing a program like this, including the cost of labor required to complete the administrative requirements to get the rebate, the need for the tune-up to be performed by skilled technicians who's time was more valuable than the money generated from the service, and the potential liability to contractor's should the unit or surrounding structure be damaged or broken during a tune-up. Aside from such challenges, contractors agreed the potential for free-ridership is significant with such a program; most of the customer's they currently perform tune-ups for are maintenance-focused individuals who specifically request the service and would be likely to have it done without the rebate. All contractors felt that a much bigger rebate would be required to convince those individuals who would not have done the tune-up otherwise.

### Water Heating Contractors

Three of the seven attendees at the workshop sell and install residential water heating equipment. The goal of the water heating discussion was to explore opportunities for EE amongst electric water heating customers, including heat pump water heaters specifically. First, we presented the details of a new Water Heating program with discounts for HPWHs that would provide an incentive of 75% of the cost. All of the water heating equipment contractors verified that the \$638 equipment cost was a reasonable assumption and agreed that the proposed incentive level would be enough to cover the incremental cost of the HPWH. Most of the water heating equipment contractors said that they rarely install ENERGY STAR® rated HPWHs, and one of the water heating equipment contractors said he has installed none. Since this workshop, DESC begin offering an incentive for HPWHs and has already incentivized a fair amount of HPWHs in the program.

### 11.2.4 Barriers

Distributors identified three key and related considerations for midstream program: customer engagement, distributor engagement, and program clarity & simplicity.

**Market Influence:** All seven contractors attending the workshop took issue with such a distributor level incentive program, arguing that giving the rebate directly to equipment distributors would simply encourage distributors to artificially raise the equipment price and keep the discount for themselves. One contractor, who had previously worked as an equipment distributor, argued that the profit margins were so narrow that contractors and the end-users would never see a dime of the rebate if it went to the distributors. All other contractors in the workshop agreed with this perspective.

**Customer Engagement:** It is important that awareness is built amongst customers that there is a program that provides savings, even if incentives are being dispersed at the distributor level. One HVAC distributor noted that is especially important for residential new construction where contractors and developers may be making

“bulk” decisions, based largely on price. As cited above, contractors (who are customers for distributors) may have incorrect understandings of efficient products that will need to be addressed, along with program incentives to influence product availability and cost.

**Distributor Engagement:** In designing the details of any program, distributors felt that it was important that they be engaged early in the process. This was identified as important to ensure that processes would work for them, and not serve as a barrier which would keep them from actively and continuously working with any program. Examples were given of customer verification schemes and incentive level schemes being too complex in some jurisdictions, or incentive payments being subject to extensive delay or at risk because of program checks and procedures.

**Clarity & Simplicity:** In addition to being engaged in the processes of developing program mechanisms and operational details, distributors also stressed that it was important that any program be clear and simple. Incentives should not have complex schemes or require calculations, for example. One distributor cited a program where only white-listed products were permitted, omitting by default highly similar products or new products of potentially greater efficiency that were simply not yet included on the list. Distributors expressed interest in a program that increases sales, but not necessarily at the cost of significantly greater administrative burden. In a workshop with two HVAC and WH distributors, neither preferred a midstream over downstream model, but also said either or both could work in the market. Both distributors agreed that a midstream \ program would only work if the midstream component was “easy”, meaning minimal paperwork and low burden of proof for the distributor. If such a streamlined midstream program is not feasible for Dominion, all agreed that the best option was to stay with a downstream model as that ensures that customers receive the greatest benefit from rate payer dollars.

**Cost & Structural Constraints for HPWHs:** When we asked the water heating equipment contractors about the main barriers preventing customers from installing more HPWHs, all agree that the cost was the main deterrent for customers. Some of the contractors also raised education as a key barrier, citing a lack of customer awareness of EE equipment and associated benefits. Lastly, some of the contractors identified the sizing constraints of HPWHs; most closets are not large enough to accommodate them, so a sizable garage or utility room is needed to fit them.

## 12. Residential New Construction Program Opportunity

The Study Team conducted limited research related to residential new construction as part of this research study since the primary focus of the study was existing housing stock in the DESC service territory. DESC offered a EnergyStar residential new construction program several years ago and following evaluation surveys closing the offering given that new construction builders indicated that they were already building to high efficiency standards and that DESC incentives did not impact meeting ENERGY STAR® requirements and their standard practices. The Study Team conducted a literature review and interviewed a representative from the Home Builder's Association as well as two prominent builders in the market to determine if there was potential to influence builders to generate savings beyond the existing state energy code and/or industry standard practices

### 12.1 Literature Review of Energy Code Best Practices

The team compiled a literature review to understand South Carolina residential building codes and determine how DSM programs focused on new construction (and existing buildings) can play a role within the scope of the state's energy code. The team spoke with a representative from the Home Builder's Association and two prominent builders in South Carolina. Table 90 below outlines the sources and materials the team used to conduct this review:

Table 90: Sources

Author(s)	Source Title	Sponsor	Year
Sadie Cox	Building Codes: Policy Overview and Good Practices	Clean Energy Solutions Center	2016
Steven Nadel and Adam Hinge	Mandatory Building Performance Standards: A Key for Achieving Climate Goals	ACEEE	2020
American Council for an Energy-Efficient Economy (ACEEE)	The State Energy Efficiency Scorecard	ACEEE	2020
Office of Energy and Renewable Energy	Status of State Energy Code Adoption – Residential	US Department of Energy	2022
Energy-Efficient Codes Coalition	The IECC: About the International Energy Conservation Code	Energy-Efficient Codes Coalition	2021
South Carolina State House	Chapter 8: Building Codes Council – Article 1, Registration Fees and Disciplinary Procedure	South Carolina Building Codes Council	2010
Victor R Salcido and colleagues from Pacific Northwest National Laboratory	Cost-Effectiveness of the 2021 IECC for Residential Buildings in South Carolina	U.S. Department of Energy	2021
South Carolina Energy Office	Saving Energy: How Electric and Natural Gas Utilities in South Carolina Are Using Demand-Side Management	South Carolina Energy Office	2021
Southeast Energy Efficiency Alliance	South Carolina Residential Building Report	Southeast Energy Efficiency Alliance	2017

There are no federally enforced building energy codes in the United States, building codes are determined at the state level. In addition, there is variation among the types of energy codes that are enforced and the degrees of stringency attached to those standards. While the International Energy Conservation Code (IECC) is updated every three years to reflect changes in EE technology and more implementation opportunities<sup>26</sup>, some states may update their energy codes to reflect these updates while many may not for years.

As of the time of this study, only three states in the country have codes equivalent to the 2021 IECC – California, Vermont, and Washington<sup>27</sup>. However, there are other states that have standards not too far behind. Massachusetts is currently operating under the 2018 IECC, with additional amendments and stretch codes pertaining to residential renewable energy prep requirements, cold-climate heat pumps, and net-zero building standards<sup>28</sup>. Oregon also follows residential energy standards equivalent to IECC 2018 with stretch codes that cover mandatory EE measures for building envelopes, furnaces, water heaters, heat pumps, and more<sup>29</sup>.

While there are many states that implement and enforce up to date (or almost-up to date) energy codes, many have not updated their standards beyond the 2009 IECC, and some do not have a statewide energy code at all (otherwise known as “home-rule” states). Mississippi, for example, is a home-rule state where an estimated 60% of residents live in an area where building codes are equivalent to 2006 IECC standards<sup>30</sup>. Wyoming falls farther beneath this threshold, with ACEEE ranking it as the worst state in the US on their energy efficiency scorecard due in part to its lack of local or statewide implementation of energy codes<sup>31</sup>.

South Carolina joins a large coalition of states that still reference the 2009 IECC<sup>32</sup>. In fact, all Southeastern states still reference the 2009 IECC or a prior version<sup>33</sup>. While the 2009 standards address important measures like thermal envelopes, heat pumps, attic insulation, sealing, lighting, etc. for new and existing homes, they lag behind the more stringent and technologically updated standards of the current IECC.

The building energy code of South Carolina (including both residential and commercial) is adopted and enforced by the SC Building Codes Council (BCC) and is mandatory in every county and locality in the state. The BCC is responsible for reviewing IECC updates and determining whether the state will move forward with the new standards, as shown in Figure 27 below.

Figure 27: South Carolina Building Code Implementation Process



The BCC is also responsible for reviewing code modification requests submitted by counties or localities<sup>34</sup>, as demarcated by the arrow in Figure 27. However, the petitioner or petitioning body must have a “physical” or

<sup>26</sup> Ibid.

<sup>27</sup> Office of Energy Efficiency and Renewable Energy.

<sup>28</sup> American Council for an Energy-Efficient Economy.

<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

<sup>31</sup> Ibid.

<sup>32</sup> American Council for an Energy-Efficient Economy.

<sup>33</sup> Office of Energy Efficiency and Renewable Energy.

<sup>34</sup> South Carolina State House.

“climatological” basis for modifying the standards, as well as prior approval by the local governing body for the BCC to consider allowing the change<sup>35</sup>. If approved, the standards can only be adopted in that specific locality; the existing standards would remain mandatory for the rest of the state. This aims to prevent localities from operating below the statewide standards, but also potentially poses a challenge to localities looking to implement “stretches” to the code.

### 12.1.1 Variation within South Carolina

From our research of accessible information, there is little to no variation in residential building energy codes throughout the populous regions of South Carolina. This includes stretch or reach codes, which were not discovered to be in place in any major locality within the state. Richland, Charleston, and Greenville counties, all of which are some of the most populated areas in South Carolina, all abide by the 2009 IECC<sup>+</sup>. The same is true for major towns and cities as well, like Clemson, Myrtle Beach, Columbia, Hilton Head, and Beaufort<sup>+</sup>.

The lack of variation demonstrates that South Carolina holds untapped energy and demand savings potential, as well as untapped financial benefits for its residents. Residential building energy codes have the opportunity to not only propel South Carolina towards its own efficiency goals and the existing standard set by the IECC, but to also financially benefit residents in the long run. The Pacific Northwest National Laboratory found that if South Carolina were to update its IECC to 2021 standards, homes could see annual savings of \$600 or more across energy loads including heating, cooling, water heating, lighting, and vents<sup>36</sup>.

### 12.1.2 Demand-Side Management (DSM)

DESC’s DSM programs have had a primary focus on existing housing stock, low to moderate income customer and small business customers. However, there are DSM programs offered by other utility companies in South Carolina, though, there is a deficit of them directly aimed at new building efficiency incentives<sup>37</sup>, as reported by SC’s Energy Office.. Duke Energy Progress (DEP) offers a Residential New Construction program providing financial incentives to builders who construct new single and multifamily homes to a high efficiency standard<sup>38</sup>. Santee Cooper also offers a new construction program, providing builders with rebates based on a prescriptive efficiency rating system<sup>39</sup>.

### 12.1.3 Further Stakeholder Involvement

EE building codes and programs do not occur in a vacuum – instead they involve many actors who work to achieve the same goals of increased savings, and decreased consumption. Stakeholders such as utilities, co-ops, municipalities, home building associations and others can consider their role in this process and their potential to influence statewide residential energy codes. Figure 28 below demonstrates a hypothetical pathway of influence where SC utilities, municipalities, etc can not only build up-to-date IECC standards into their own DSM programs, but also influence the statewide code adoption process as well.

<sup>35</sup> Ibid.

<sup>+</sup> This information was found on publicly accessible county and city government websites.

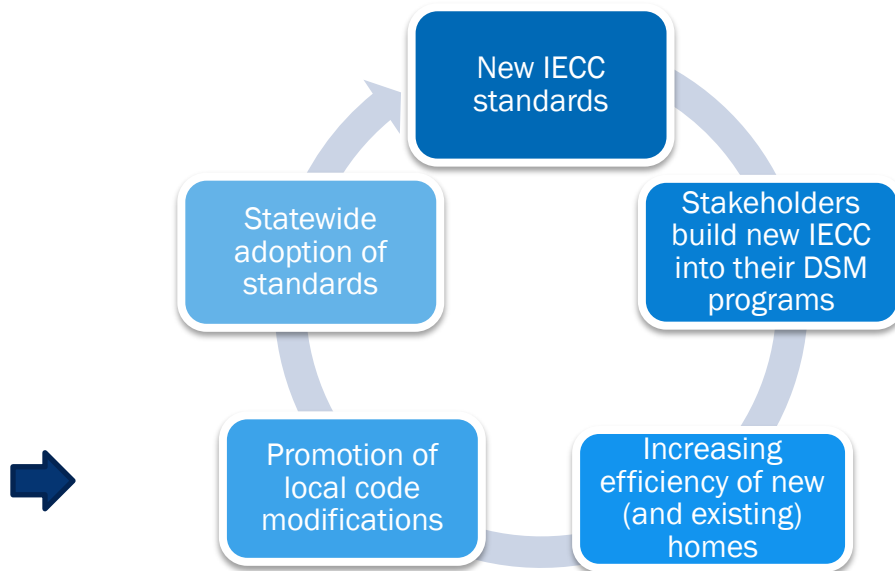
<sup>36</sup> Salcido R., Victor, et al.

<sup>37</sup> South Carolina Energy Office.

<sup>38</sup> Ibid.

<sup>39</sup> Ibid.

Figure 28: Proposed Pathway of Influence for Residential Energy Codes



The key stakeholders involved in residential energy code design, scope, adoption, implementation, and enforcement in South Carolina (and elsewhere) include government actors such as the SC state legislature and Building Codes Council, the International Code Council (ICC), technical institutions, builders and construction companies, and utilities<sup>40</sup>. Moreover, utilities have a unique opportunity to influence the adoption and implementation process of energy codes through certain interventions, demarcated by arrows in Figure 28 above. By incorporating the newest IECC standards into DSM programs targeted at new construction and existing buildings (i.e. rebates and incentives), utilities can further increase the efficiency of new and existing SC homes. Simultaneously, they can work to educate stakeholders like local policymakers in utility service territories on the benefits of up-to-date IECC standards with the goal of aiding its adoption<sup>41</sup>. This takes advantage of SC's compliance and enforcement protocol set by the BCC, an already existing best practice in the state for building energy codes<sup>42</sup>.

## 12.2 Market Forces

The market for residential new construction in South Carolina is robust at the start of 2022, despite the various challenges presented by the COVID-19 pandemic including distancing restrictions, temporary shutdowns of some industries, supply chain shortages, and an inflationary market. According to the Richmond Federal Reserve's March 2022 snapshot, new private housing unit permits were up over 14% from January 2021 to January 2022. This growth is not universal however, as only the Columbia and Greenville metropolitan statistical areas (MSAs) experienced significant growth while all other SC MSAs experienced negative or flat growth, as shown in Figure 29 below from the Richmond Federal Reserve's snapshot<sup>43</sup>.

<sup>40</sup> Cox, Sadie.

<sup>41</sup> Ibid.

<sup>42</sup> Ibid.

<sup>43</sup> [https://www.richmondfed.org/-/media/richmondfedorg/research/regional\\_economy/reports/snapshot/pdf/snapshot\\_sc.pdf](https://www.richmondfed.org/-/media/richmondfedorg/research/regional_economy/reports/snapshot/pdf/snapshot_sc.pdf) as accessed March 18, 2022.

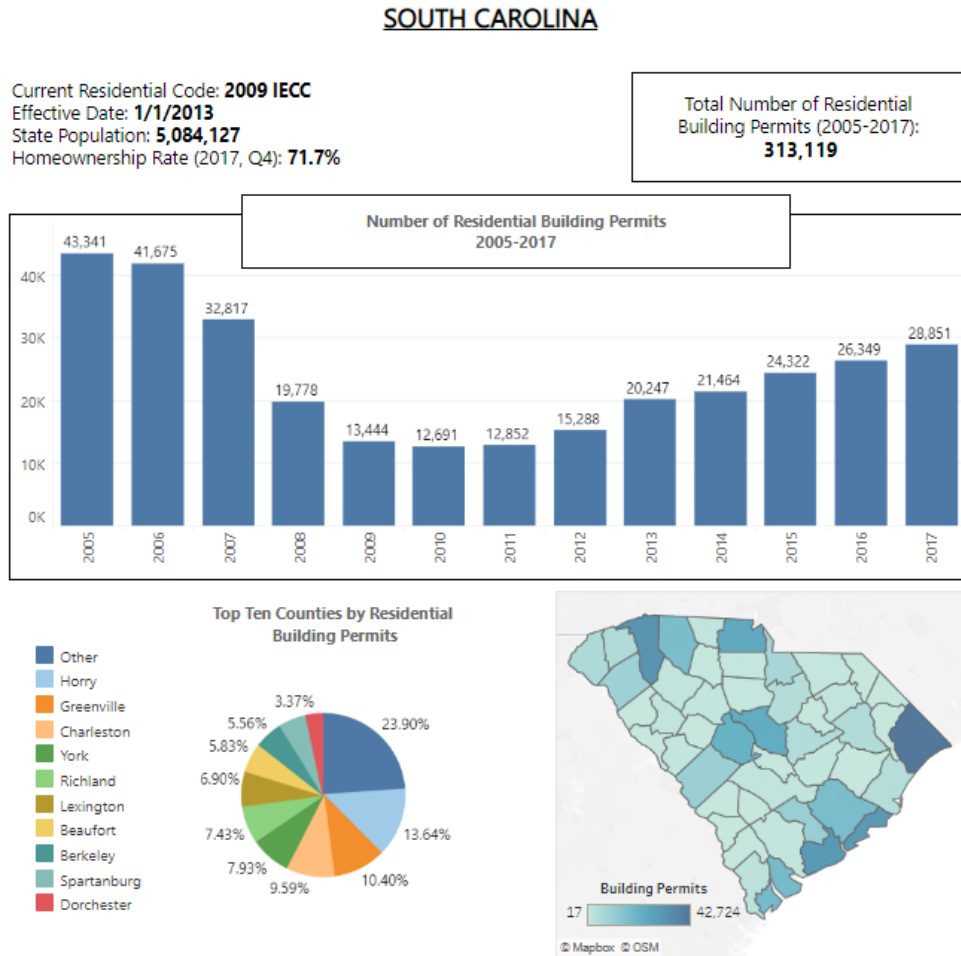
Figure 29. Permits: Private Housing Units

Permits: New Private Housing Units (NSA)	Period	Level	MoM % Change	YoY % Change
United States	January	132,316	-13.60	2.70
Fifth District	January	17,235	14.59	16.47
South Carolina	January	4,124	19.23	14.24
Charleston MSA	January	712	8.70	0.28
Columbia MSA	January	970	137.16	121.46
Florence MSA	January	34	-20.93	-63.83
Greenville MSA	January	730	-4.70	23.94
Myrtle Beach MSA	January	669	9.14	-8.10
Spartanburg MSA	January	260	7.88	-5.45
Sumter MSA	January	25	-56.14	-28.57

The Southeast Energy Efficiency Alliance (SEEA) most recent South Carolina Residential Building Report<sup>44</sup> captures the new housing permits filed annually between 2005 and 2017. New construction permits have increased each year in the State between 2013 and 2017. In 2017, there were roughly 28,000 residential building permits issued.

<sup>44</sup> Website on 6/12/22: <https://www.seealliance.org/initiatives/built-environment/regional-trends-analysis/residential-building-reports/south-carolina-residential-building-report/>

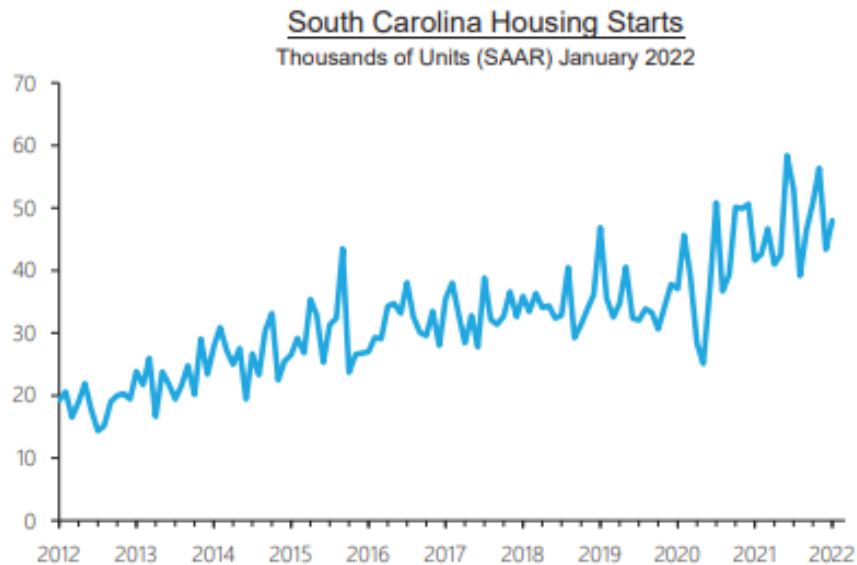
Figure 30: South Carolina Residential Building Permit Data 2005-2017



Source: Southeast Energy Efficiency Alliance, Residential Building Report 2005-2017

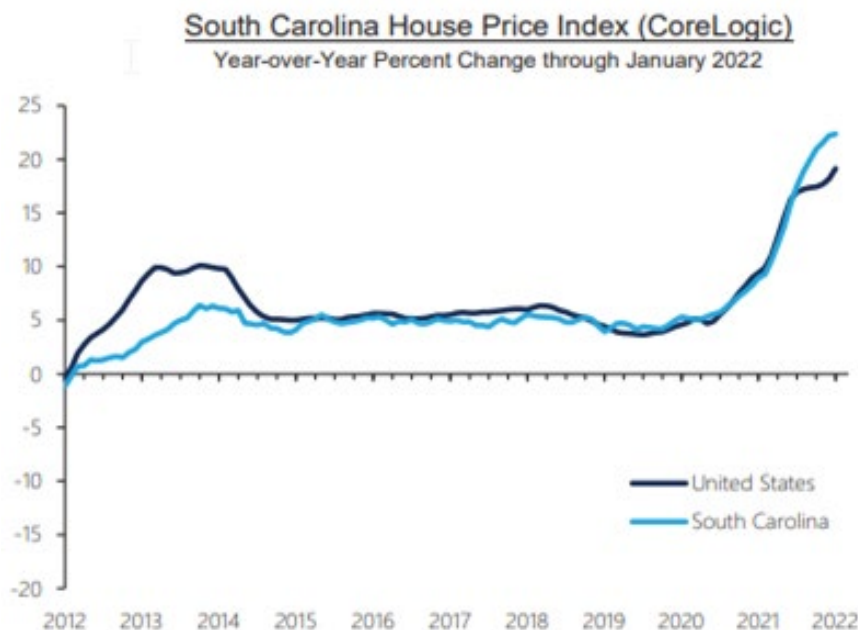
As shown in Figure 31 the trajectory of new housing starts in South Carolina continues a long-term trend of consistently adding capacity to new housing starts, a trend going back to at least 2012 as seen in the previous figure. In recent years, 2021 and 2022 building permits have increased to approximately 55,000 annually, This is consistent with the current housing market in the United States.

Figure 31. South Carolina Housing Starts



As a result of the continued growth in the demand for housing, there is significant pressure driving up the cost of housing. The Federal Reserve Bank of Richmond shows a dramatic increase in the cost of housing year to year in South Carolina and the United States as a whole (Figure 32).

Figure 32. South Carolina House Price Index



As previously mentioned, Opinion Dynamics conducted interviews with a representative from the Home Builder's Association and representatives from two prominent builders in South Carolina. Both the rising cost of housing and the rising demand for additional new construction were cited during conversations about

energy efficiency programs and their potential to encourage additional efficiency in new construction. According to the representative from the Home Builder's Association, the market is actively advertising energy efficiency in new home construction sales which appears to resonate with buyers in today's market. Buyers are hoping that increased energy efficiency and a low Home Energy Rating (HERS) will allow for energy savings and less money spent on utilities, which as a result, will justify more money spent on a home. The rising cost of homes and the rising cost of other household expenses has, it was claimed, prompted builders to construct above minimum code requirements for increased energy efficiency and they are using the added efficiency (and the lower energy bills) as a selling point in marketing. Homebuilders are, it was claimed, competing in many areas to attract the most buyers and extract the best price for the homes.

To corroborate this claim, the team searched for evidence of energy efficiency in marketing from some of the area's largest home builder websites. Of the five websites reviewed, four contained references to green-living, energy efficiency, or energy savings with dedicated pages for customers focusing on these topics<sup>45</sup>. A fifth major builder's website contained a focus on providing customers with "America's Smart Home"<sup>46</sup> which included energy efficiency as a key feature. Below, Table 91 shows a list of EE measures marketed on the websites of two prominent builders in South Carolina. This supports the claim that builders are building to more efficient standards than existing building code and using energy efficiency as a marketing point in South Carolina. However, information from these marketing materials indicates that more EE is possible even though current practices may produce a high enough HERS rating to qualify as ENERGY STAR®. For example, one builder is putting in 14 SEER HVAC systems and those could be more efficient at higher SEER levels but still pass the HERS threshold for ENERGY STAR®, one builder claims to install EE air conditioning units but does not specify the level of efficiency, and it's possible that more electric savings could be garnered by incenting the installation of electric heat pump technology for space and water heating instead of gas fueled models.

Table 91. Examples of Energy Efficiency Measures in New Construction Marketing

Prominent South Carolina Builder 1	Prominent South Carolina Builder 2
R-38 Attic Insulation	ENERGY STAR® Qualified Refrigerators and Dishwashers
Low-E Insulated Single-hung Vinyl Windows w/ Tilt Out	Low Flow Toilets, Faucets, and Showers
Gas Heat (2nd Floor Electric Heat Pump if Separate System)	Insulation and Air Barrier Package
HERS Testing & Rating by Third Party	EE air conditioning units with R-410A Refrigerant
Separate HVAC System or Zone for Each Floor Plan	
14-SEER Energy-efficient HVAC System	
Energy-efficient Insulation package	
LED Lighting Throughout Home	
Programmable Thermostat	
Air Barrier & Sealing	
Tankless Gas Water Heater for Endless Hot Water	
Water-saving Faucets and Shower Heads	

<sup>45</sup> <https://www.mungo.com/energy-savings> , <https://www.ryanhomes.com/builtsmart>, <https://www.stanleymartin.com/homebuyer-resources/green-living>, <https://www.greatsouthernhomes.com/live-green>,

<sup>46</sup> <https://www.drhorton.com/smart-home>

## 12.3 Conclusion

This study did not serve to complete a full review of the new construction practices in the DESC service territory as the focus was primarily on existing housing stock. DESC attempted a new construction program in the initial roll-out of the DSM portfolio over 10 years ago. That program was designed to align with the national ENERGY STAR® New Homes Program. The program was sunsetted within its first three years due to overwhelmingly high levels of free-ridership amongst the State's most active builders who claimed, following evaluation surveys, they were already building to these standards regardless of the program support. Based on the limited research conducted for this study, inconclusive results suggest that there is more research or analysis that could be done to fully explore the opportunities DESC has for implementing effective energy efficiency programs in the area of new construction. Our limited research indicates that there is ample residential new construction happening in South Carolina and that it is projected to increase in the near-term. Concurrently, outdated codes are not requiring highly efficient installation practices of the heating and cooling equipment for residential new construction. Builders instead are claiming that they already build above/greener than code to stay competitive in the marketplace. Although this has not been verified in the field, energy efficiency is becoming important enough to home buyers that home builders in the state are using efficiency claims as marketing tactics. However, based on our review of builders marketing and website content as well as our mystery shopper calls, builders are doing so largely without updated tools to measure or provide a coherent definition to what constitutes a "green" or "efficient" home.

## 13. Winter Peak Demand Response Programs

This section explores the opportunities and barriers for managing winter peaking demand response amongst DESC residential customers.

### 13.1 Why Winter Demand is Important to Southeast Utilities

As prolonged cold snaps and unexpected bouts of cold weather become more common, states that were previously summer peaking have a higher chance of transitioning to winter or dual peaking. While they are typically shorter in duration than summer peaks, consecutive hours of cold over multiple days challenges the grid not only by increased demand for electricity, but also by potentially compromising essential power generation systems aimed at meeting hiked demand<sup>47</sup>. Winter peaks will also occur more frequently as electrification continues to grow, specifically the additional load added by the uptake of electric vehicles (EVs) and electrical heat pumps<sup>48</sup>.

Daily winter peaks are also of concern as well. Typical winter load shapes have a notable increase in demand during the morning hours from the residential sector as space and water heaters are coming on, typically between 7 am and 9 am<sup>49</sup>. Another bump in demand is observed during the evening as people return home to work, once again increasing demand. These two time periods of the day are the highest points of winter demand in a typical 24-hour timeframe.

According to a report released by the Southern Alliance for Clean Energy, the Southeast region as a whole is dual peaking; however, DESC is categorized as dual peaking/transitional, signaling a potential shift to becoming a winter peaking utility; it would join eight other SE utilities classified as such<sup>50</sup>. This is also supported by ACEEE's mid-century model, which, even in a low electrification scenario, shows an increase in winter-peaking hours for the Southeast by 20%<sup>51</sup>.

The changing landscape of how customers heat their homes and the timeframes in which customers do so is an evolving issue for utilities. As demand for electricity increases, unless the proper infrastructure and demand response protocols are in place to mitigate peak demand, the reliability of the grid comes into question. As more utilities across the country transition to winter-peaking and/or experience changing winter load shapes, they must be prepared to adapt to these changes.

### 13.2 Literature Review Demand Response

Demand response can look different depending on load type and the customer base being served. The following subsections will explore various winter load types and demand response measures, as well as pertinent winter demand response programs in the United States that address some of these topics. Table 92 presents the sources referenced in this demand response deep dive.

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<sup>47</sup> Specian, Mike, et al.

<sup>48</sup> Ibid.

<sup>49</sup> Ibid.

<sup>50</sup> Wilson, D. John and Maggie Shober.

<sup>51</sup> Specian, Mike, et al.

Table 92. Winter demand response sources

Author(s)	Source title	Sponsor	Year
Specian, Mike, et al.	Demand-Side Solutions to Winter Peaks and Constraints	ACEEE	2021
Wilson, John D., and Maggie Shober.	Seasonal Electric Demand in the Southeastern United States	Southern Alliance for Clean Energy	2020
Dunsky Energy Consulting	Duke Energy Winter Peak Demand Reduction Potential Assessment	Duke Energy	2020
PLMA Load Management Leadership	PLMA: Heating Up Water Heater DR: Results and Lessons Learned from a Winter Pilot	Southern Company	--
ILLUME Advising, LLC	Water Heater Demand Response Pilot: Final Evaluation Report	Georgia Power Company	2019-2020
Santee Cooper	Santee Cooper Empower SmartRewards™ Program: Terms and Conditions	Santee Cooper	2022
Seminole Electric Cooperative, Inc.	Cooperative Rewards FAQ	Local Electric Cooperatives	2021

### 13.2.1 Demand Response and Load Types

Activity during the early morning and early evening are the primary contributors to daily winter electricity loads for utilities<sup>52</sup>. As mentioned, this is due to a combination of residential space heaters, electric heat pumps, and water heaters in the morning, and residential heating ramping back up in the evening. With these load shape characteristics in mind, utilities can begin to pinpoint the best ways to address these peak periods of demand on the grid. Table 93 breaks down customer categories and load types. It highlights which DR technologies are best tailored to them.

Table 93: Demand response/energy efficiency measures across load types

Load type	Smart thermostats	Electric heat pump water heaters	Electric air source heat pumps	Weatherization	Rates and rebates (CPP, TOU, PTR)
Water heating		✓			✓
Whole house	✓		✓	✓	✓
Space heating	✓		✓	✓	✓

The DR technologies outlined in Table 93 include:

<sup>52</sup> Ibid.

- **Smart Thermostats..** As previously mentioned, residential heating is one of the largest contributors to increased demand during the morning and evening hours of a typical load shape curve. By incentivizing customers to install smart thermostats and enroll in DSM programs, utilities can reduce peak demand by controlling the temperature at which residents heat their home during those critical hours or events<sup>53</sup>. For example, preheating a home is common practice to avoid expending energy to actively heat a home during peak demand hours.
- **Electric Heat Pump Water Heaters (HPWHs).** HPWHs offer energy savings through their high-efficiency usage of electricity to heat water for homes and businesses. Like smart thermostats, HPWHs have become a growing source of demand reduction for utilities through remote controlling. Preheating a water tank prior to a high period of demand during a peak event, for example, allows utilities to lessen the load of a given demand period.
- **Electric Air Source Heat Pumps (ASHPs).** Electric ASHPs technologies are extremely efficient and promote energy savings, which will benefit customers and utilities in the long run and help bolster the adoption of demand response programs<sup>54</sup>. DESC's residential market is well positioned with this technology already present in about 52% of homes.
- **Weatherization.** Updating the thermal envelope of a home not only makes heating more efficient by limiting air leakage, but it can be a powerful aid to other DSM measures such as preheating a home ahead of a peak demand window<sup>55</sup>. This thermal envelope is extremely important for winter demand response efforts, especially during times of prolonged cold where heating systems are more likely to be running during peak load periods of the day.
- **Rates.** Rates such as TOU and Critical Peak Pricing (CPP) are effective ways of changing customer behavior as it relates to their energy usage. By increasing the price per KWH of electricity during times of peak or critical peak demand, customers will want to consume energy during cheaper time periods.<sup>56</sup>
- **Rebates.** Rebates and incentives can be offered in a wide variety of ways and capacities. The following sections detail several winter demand response programs that focus on the use of incentives and rebates to drive up customer participation and drive down demand during peak periods. Smart thermostats, electric heaters, and electric water heaters are great candidates for demand response programs with incentives and are quite common.

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<sup>53</sup> Specian, Mike, et al.

<sup>54</sup> Ibid.

<sup>55</sup> Ibid.

<sup>56</sup> Ibid.

### 13.2.2 Existing Demand Response Programs

The following subsections detail several examples of winter demand response programs offered by Southeastern utilities, including smart thermostats and water heaters in single family residential homes. The winter DR programs discussed in this review are detailed in Table 94.

Table 94. Winter Demand Programs

Utility	Program/pilot	Type	Seasonal peak
Georgia Power	Water Heater DR Pilot	Residential electric water heaters	Summer peaking*
Seminole Electric Cooperative	Smart Thermostat "Cooperative Rewards" Pilot	Residential smart thermostats	Winter peaking
Santee Cooper	Empower SmartRewards™ Program	Residential electric heating and cooling, electric water heating	Winter peaking
Alabama Power	Residential Time Advantage Demand Rate Plan	Residential TOU	Dual peaking/transitional

\*DR Program is active in the winter as well

#### Georgia Power Water Heater Demand Response Program

Georgia Power launched a Water Heater Demand Response Pilot during 2018 to investigate how much demand shift and load shed could occur with water heaters during demand response events in the winter (and summer) of 2019<sup>57</sup>. The pilot involved 100 participants with HPWHs and electric resistance water heaters of various sizes (50, 66, and 80-gallon tanks). Georgia Power called 5 DR events during the winter (as well as the summer), taking place in the early morning hours anytime between 4:30 am – 10:00 am during the months of January, February, and March 2019. For each load shift event, Georgia Power preheated the water by increasing the setpoint to 140 degrees Fahrenheit. During the load shed event, the setpoint was reduced to 110 degrees Fahrenheit until after the DR event was over<sup>58</sup>.

The Study Team found that only the summer DR events yielded net energy savings; for the winter DR events, energy usage increased overall. While the load sheds decreased energy usage, the preheating and post-heating of the water offset the savings accrued during load shed<sup>59</sup>. A possible explanation was the type of water heater, as electric resistance heaters performed better than HPWHs. However, customer satisfaction with the water heaters was high and most would participate in a future program<sup>60</sup>. The results of this pilot show that, while savings are derived from water heater demand response programs, the winter season poses a different kind of challenge for utilities in DR program design. Water heating DR programs also pose the challenge of getting utility-controlled switch technology in place on existing water heaters or increasing installation of HPWHs as a precursor to participation.

<sup>57</sup> ILLUME Advising, LLC.

<sup>58</sup> Ibid.

<sup>59</sup> Ibid.

<sup>60</sup> PLMA Load Management Leadership.

### Seminole Electric Smart Thermostat “Cooperative Rewards” Pilot

Seminole Electric Cooperative launched a Smart Thermostat pilot program called Cooperative Rewards aimed at reducing energy usage during times of high demand in the summer and winter. Floridians in Cooperative territory with eligible smart thermostats were offered an initial \$25 incentive for participation and a chance to win a \$250 gift card at the end of the program in April 2022 if they participated in most of the DR events (or “temperature adjustments”)<sup>61</sup>. In the winter, up to 15 events could be called between 6 am and 10 am. In the event of extremely “critical” demand, an event could be called at any point. Once the event is over, thermostats reset to desired temperatures. This program is still ongoing.

### Santee Cooper Empower SmartRewards™ Program

Santee Cooper in South Carolina has launched a demand response program – Empower SmartRewards™ - that installs utility-controlled switch technology on electric heating and cooling systems, as well as electric water heaters capable of holding 30 gallons or more. Residential customers in single-family homes who live in Santee Cooper service territory and already have these products installed in their home are eligible to participate in exchange for varying levels of incentives, depending on how many systems are hooked up to controllable switches. The DR events that take place in the winter could be anytime between 6am – 10am and 6pm - 9pm during December 1 – March 31. Each event will be no longer than four hours and will switch system off and on throughout the event period. This program is ongoing and is actively recruiting participants.

### Alabama Power Residential Time Advantage Demand Rate Plan

Since 2011, Alabama Power has offered customers living in single family homes or individual family apartments a TOU rate plan that allows them to save on their electricity bills by shifting energy usage to off-peak hours. During the winter, this program runs from November 1st through March 31st with a designated peak pricing of 9.5359 cents per KWH during weekdays from 5:00 am – 9:00 am, and off-peak pricing of 7.5359 cents per KWH at all other times, including weekends<sup>62</sup>. The utility offers example appliances that serve as appropriate candidates for shifting their usage to off-peak periods, such as water heaters, electric heating systems, common kitchen appliances, clothes washer and dryers, ovens, and more. By limiting usage of these systems and appliances simultaneously during peak periods (if at all), customers accrue sizable savings throughout the year while limiting their demand.

## 13.3 Opinion Dynamics Demand Response Study

As part of this market study, the team explored customer interest and likelihood to engage with select DR solutions suitable for curtailing load during the winter peaks. The potential DR programs were a Smart Thermostat Program and a TOU Rate Program.

### 13.3.1 Smart Thermostat Program

One potential avenue for reducing winter peak load is a Smart Thermostat DSM Program. Before exploring the likelihood of DESC customers participating in a Smart Thermostat Program, it is important to understand customers’ awareness of and attitudes around the technology, as well as the current penetration of the technology.

<sup>61</sup> Seminole Electric Cooperative, Inc.

<sup>62</sup> Alabama Power.

The Study Team asked respondents if they had heard of smart thermostats prior to the survey. Overall, 82% of respondents indicated that they had heard of a smart thermostat prior to the survey. Having no awareness of smart thermostat technology is an immediate limiting factor to participation in a smart thermostat based DR program. Further, a significantly smaller percentage of low income respondents indicated hearing of smart thermostats before (63%), further limiting the participation of this customer segment. Table 95 presents the percentage of respondents that indicated hearing of thermostats prior to the survey by customer segment.

Table 95. Awareness of smart thermostats

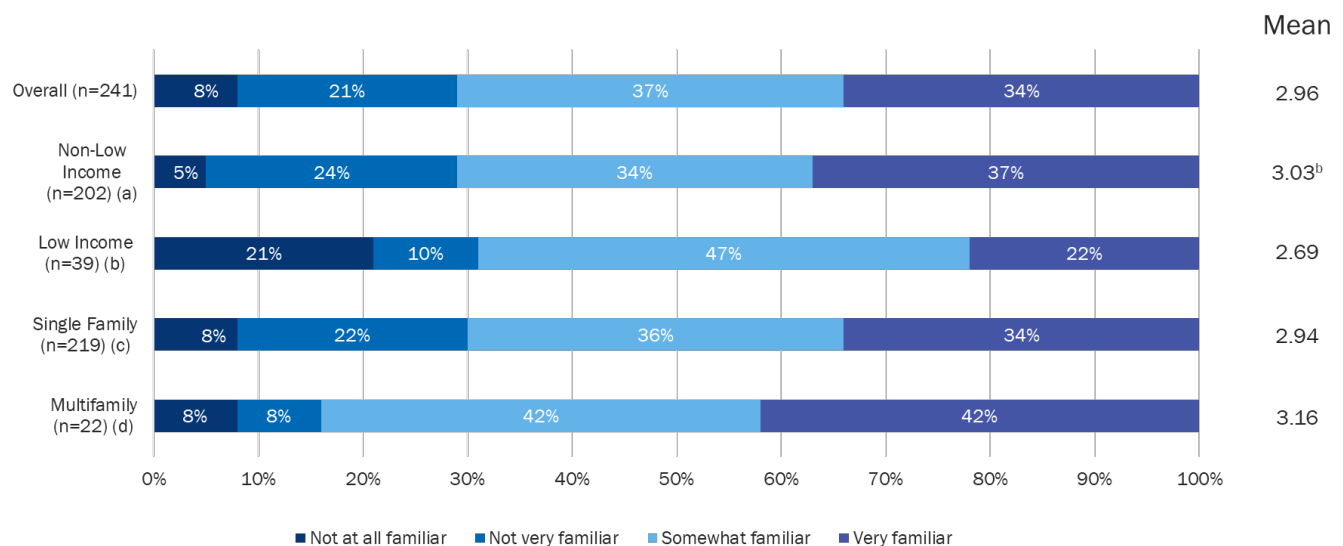
	n	Heard of smart thermostats
Overall	288	82%
<b>Income status</b>		
Non-low Income (a)	227	89% <sup>b</sup>
Low Income (b)	61	63%
<b>Housing type</b>		
Single Family (c)	262	82%
Multifamily (d)	26	87%

Note: Results based on web survey data – respondents with eligible heating and/or cooling systems

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team asked those respondents that indicated they had heard of smart thermostats prior to the survey to rate their level of familiarity with smart thermostat technology on a scale of 1 “not at all familiar” to 4 “very familiar”. Overall, those respondents that indicated they had heard of smart thermostats prior to the survey rated their familiarity with the technology as “somewhat familiar” on average, and 29% indicated they were “not at all” or “not very familiar” indicating they had an aided awareness of smart thermostats but little to no knowledge of the capabilities of this technology. This suggests a lack of smart thermostat technology awareness that may be a barrier to Smart Thermostat DR Program Participation. Notably, non-low income respondents had a significantly larger mean score than low income respondents (3.03 vs. 2.69), indicating that non-low income respondents are more familiar with smart thermostats than low income respondents and may face less barriers to Smart Thermostat DR Program participation based on technology awareness. Figure 33 presents the frequency of each response by percentage and mean score, broken down by customer segment.

Figure 33. Familiarity with smart thermostats



Note: Results based on web survey data – respondents with eligible heating and/or cooling systems and heard about smart thermostats prior to the survey

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Currently, few DESC customers have smart thermostats installed in their homes. This is a significant barrier to Smart Thermostat DR Program participation, as customers would be required install a smart thermostat prior to being eligible to participate. Whether installation is at the responsibility/cost of the customer or covered by the utility would greatly affect participation rates. According to the on-site visits, 6% of households have a smart thermostat. Interestingly, customers reported higher penetration on the residential web survey (31%) indicating that customers have a hard time accurately reporting their thermostat type.

Because having a smart thermostat installed is a limiting factor to participating in a Smart Thermostat DR Program, it is important to understand if customers without a smart thermostat have ever considered replacing their current thermostat with a smart thermostat. Only 30% of respondents without a smart thermostat indicated they had considered replacing their current thermostat with a smart thermostat in the past (Table 96).

**Table 96. Considered replacing thermostat with smart thermostat**

	n	Replacing existing thermostat
Overall	198	30%
<b>Income status</b>		
Non-low Income (a)	148	33%
Low Income (b)	50	22%
<b>Housing type</b>		
Single Family (c)	182	29%
Multifamily (d)	16	34%

Note: Results based on web survey data – respondents with eligible heating and/or cooling systems that do not currently have a smart thermostat

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

The Study Team dove in deeper to understand why those respondents that indicated they had considered replacing their current thermostat with a smart thermostat had not done so. The most common reasons respondents indicated was because it was too expensive (47%) and/or wasn't a priority (30%). Fewer respondents indicated that they were waiting for their current thermostat to break (19%), needed additional education on which product to buy (19%), or faced technical issues that prevented them from installing a smart thermostat (13%). Few respondents indicated that they had "other" reasons (6%), wanted a contractor to install it (5%), or were waiting for the technology to get better (3%). Table 97 presents the percentage of respondents that indicated each potential barrier.

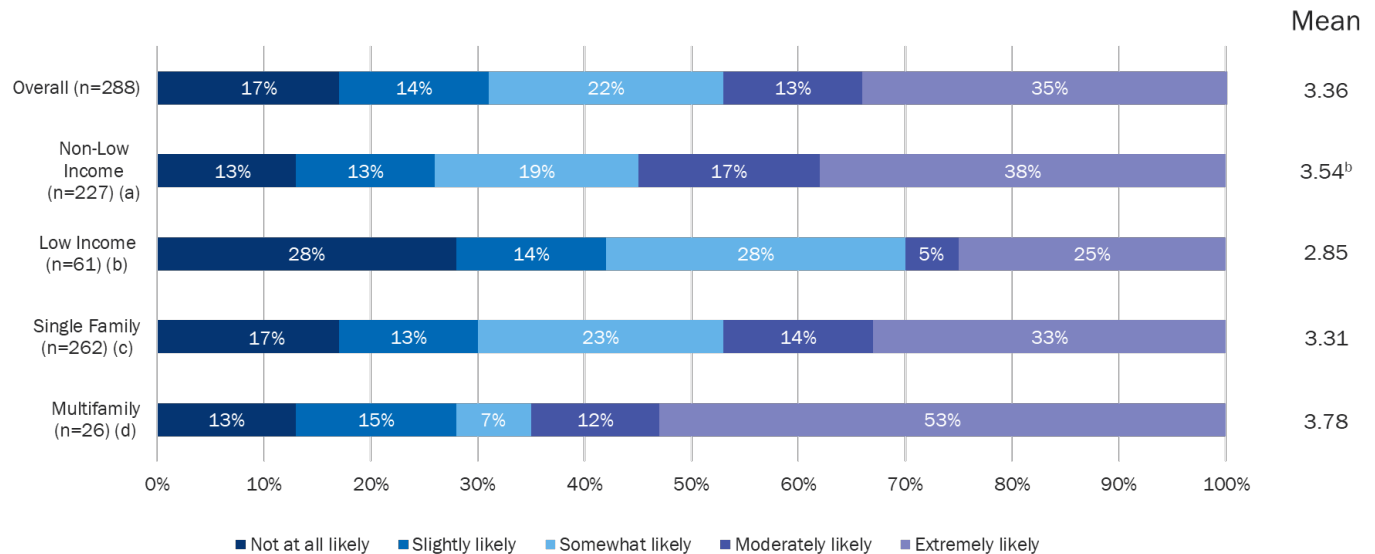
**Table 97. Reasons for not installing a smart thermostat**

<b>Reason for not installing a smart thermostat</b>	<b>Overall* (n=60)</b>
Costs too much	47%
Technical issues – could not install	13%
Never got to it – not a priority	30%
Waiting for my current thermostat to stop working	19%
Waiting for technology to get better	3%
Want to have contractor install it	5%
Need additional education on which product to buy	19%
Other	6%

Note: Results based on web survey data – respondents with eligible heating and/or cooling systems that do not currently have a smart thermostat, but considered replacing their current thermostat with a smart thermostat in the past  
a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd\*Overall results only due to insufficient sample for customer segment breakdown

The Study Team asked customers how likely they would be to replace a broken thermostat with a smart thermostat. Web survey respondents were slightly more than “somewhat likely” to replace a broken thermostat with a smart thermostat. Notably, 17% of respondents indicated they were “not at all likely” to do so. non-low income respondents reported being more likely than low income respondents to install a smart thermostat when their current thermostat breaks. Figure 34 presents the frequency of each response by percentage and mean score, broken down by customer segment.

Figure 34. Likelihood of replacing a broken thermostat with a smart thermostat



Note: Results based on web survey data – respondents with eligible heating and/or cooling systems

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

### Smart Thermostat Program Adoption

Table 98 displays the residential adoption curve current estimates for the winter Smart Thermostat DR Program broken down by income status (non-low income and low income) and housing type (single family and multifamily). Residential adoption curves for the summer Smart Thermostat Demand Response Program can be found in Appendix B. As mentioned previously, these adoption curves are based on initial results and assumptions from the residential web survey. The Study Team will work with the potential model team to ensure that these curves fit within the assumptions and needs of the model inputs.

- Overall and across all segments, there was not a large increase in adoption rate between incentive levels. The annual incentives did not drastically impact respondents' willingness-to-participate.

Adoption is affected by customers financial and non-financial barriers as well as their program awareness. Increasing awareness will increase adoption estimates. Moreover, there are a few steps to increase participation in a program like the Smart Thermostat DR program: (1) increase smart thermostat penetration, (2) increase program awareness, (3) reduce barriers to participation, especially when it comes to uncertainty around the program participation process and its effects on comfort in customers' homes. Additional details on customer barriers follow in the next table (Table 98).

**Table 98. Demand response smart thermostat program adoption curve results**

	n	Incentive Level		
		Annual incentive of \$0	Annual incentive of \$25	Annual incentive of \$50
Overall	254	18%	20%	22%
<b>Income status</b>				
Non-low Income	211	18%	20%	23%
Low Income	43	18%	21%	22%
<b>Housing type</b>				
Single Family	230	18%	20%	23%
Multifamily	24	18%	18%	20%

Note: Results based on web survey data

In addition to the price of installing a smart thermostat, online survey respondents indicated a variety of barriers that may be a barrier to their participation in a Smart Thermostat DR Program. Table 99 and Table 100 present the percentage of respondents that selected each barrier. The selections in Table 100 were only presented to respondents that indicated not having a smart thermostat.

The barrier that most respondents indicated may influence their decision to participate in a Smart Thermostat Program was concerns about allowing their utility to control their thermostat(s) during events (38%). Approximately a quarter of respondents indicated that they did not have enough knowledge about the program participation process (22%), were concerned about data security due to connecting their thermostat to Wi-Fi (24%), or were concerned about potential negative impacts on comfort (home being too cold) (29%). Non-low income respondents were more likely than low income respondents to indicate that giving control of their thermostat to their utility, their data security, or potential negative impacts on comfort were a barrier to their participation.

Table 99. Barriers to participating in Smart Thermostat Program

	n	Concerns about allowing your utility to control your thermostat(s) during events	Don't have enough knowledge about the program participation process	My home doesn't have any electric systems that can reduce usage during events	Cannot change my heating usage in the winter	Concern about data security due to the thermostat's Wi-Fi connection	Potential negative impacts on comfort (home will be too cold)	Other
Overall	288	38%	22%	3%	5%	24%	29%	8%
<b>Income status</b>								
Non-low income (a)	227	44% <sup>b</sup>	23%	4%	5%	27% <sup>b</sup>	35% <sup>b</sup>	9%
Low income (b)	61	22%	17%	0%	5%	14%	12%	4%
<b>Housing Type</b>								
Single family (c)	262	39%	22%	3%	5%	24%	29%	8%
Multifamily (d)	26	34%	17%	5%	5%	19%	26%	9%

Note: Results based on web survey data – respondents with eligible heating and/or cooling systems

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

About one-fifth of respondents without smart thermostats already installed indicated that the cost of the smart thermostat (22%) or the cost of smart thermostat installation (21%) were a barrier to participating in a Smart Thermostat Program. 23% of respondents indicated that not switching to a smart thermostat because they are satisfied with their current thermostat was a barrier to participating.

Table 100. Barriers to participating in Smart Thermostat Program: no smart thermostat

	n	Satisfied with my current thermostat	Worried about the cost of smart thermostat	Worried about the cost of smart thermostat installation	Worried that smart thermostat will be difficult to operate
Overall	198	23%	22%	21%	10%
<b>Income status</b>					
Non-low income (a)	148	30% <sup>b</sup>	21%	22%	11%
Low income (b)	50	10%	24%	20%	7%
<b>Housing type</b>					
Single family (c)	182	24%	21%	21%	9%
Multifamily (d)	16	13%	34%	26%	18%

Note: Results based on web survey data – respondents with eligible heating and/or cooling systems but no smart thermostat

a/b/c/d Indicates significant differences at a 90% confidence level between the following tests: ab,cd

Only 28% of respondents indicated being aware of the concept of a DR program where customers reduce their electric usage during peak time for cash incentives or bill credits. Non-low income respondents were significantly more likely than low income respondents to indicate being aware of this type of program. This overall lack of program awareness likely negatively impacts program perception and projected participation rates.

Table 101. Awareness of direct load control DR concept

	Aware of program where customers reduce their electric usage during peak times for cash incentives or bill credits
Overall	28%
<b>Income status</b>	
Non-low income (a)	31% <sup>b</sup>
Low income (b)	21%
<b>Housing type</b>	
Single family (c)	28%
Multifamily (d)	27%

Note: Results based on web survey data

### 13.3.2 TOU Rate Program

Another potential option to manage winter load is a TOU program, referred to in our web survey as a Time-of-Day Rate Program. Unlike the Smart Thermostat Program, TOU programs rely on the initiative of the customers to actively modify their energy usage behavior.

The Study Team asked respondents to rate a series of potential barriers to participation on a scale of 1 to 5 where 1 was “not at all a barrier”, 3 was “somewhat of a barrier”, and 5 was “extreme barrier”. Table 102 presents the mean scores for each barrier broken down by customer segment. Mean scores were comparable across barriers, with all barriers falling above “slight barrier” but slightly below “somewhat of a barrier”. Lack of knowledge about the program participation process had the highest mean score and the need to use electricity mostly during peak hours had the lowest. This indicates that the structure of the program and lack of knowledge of participation are bigger barriers to customers than their ability to modify their energy usage to avoid peak times.

Table 102. Time-of-Day Rate Program barriers

	n	The cost of the rate during the peak period	Lack of knowledge about current usage and likely savings	Lack of knowledge about the program participation process	Your need to use electricity mostly during peak hours
Overall	414	2.87	2.82	2.89	2.69
<b>Income status</b>					
Non-low income (a)	287	2.83	2.73	2.86	2.58
Low income (b)	127	2.95	3.00 <sup>a</sup>	2.94	2.93 <sup>a</sup>
<b>Housing type</b>					
Single family (c)	311	2.91	2.83	2.87	2.67
Multifamily (d)	103	2.74	2.81	2.94	2.75

Note: Results based on web survey data

### TOU Rate Program Adoption

The Study Team asked respondents how likely they would be to participate in a Time-of-Day Rate Program at four different on-peak/off-peak rates. Because the rates detailed in each scenario are unique, and neither the on- or off-peak is held consistent, the adoption results presented for the Time-of-Day Rate Program are specific to each scenario. The results present the rate of adoption for four, mutually exclusive scenarios. Table 103 displays the residential adoption results for the Winter Time-Of-Day Rate Program broken down by income status (non-low Income and low income) and housing type (single family and multifamily). Adoption results for the Summer Time-of-Day Rate Program can be found in Appendix B.

Time-of-Day Rate Program adoption shows a small but consistent increase with decreasing off-peak rate and increasing on-peak rate, with overall adoption increasing from 16% at an off-peak rate of 10 cents/KWH to 23% at an off-peak rate of 4 cents/KWH. This suggests that customers are more open to the idea of modifying when they use energy the lower the cost would be if they successfully modified their usage behavior, despite increasing on-peak rates.

Single family adoption was higher than multifamily adoption across all scenarios. Single family also had larger incremental increases in adoption than multifamily as the on-peak rate increased and the off-peak rate

decreased. Low income adoption was higher than non-low income adoption for the first two scenarios. Their adoption was equal (21%) for the third scenario, but then flipped with non-low income adoption being higher than low income adoption for the scenario with the lowest off-peak rate but highest on-peak rate. Non-low income also had larger incremental increases in adoption than low income as the on-peak rate increased and the off-peak rate decreased. This suggests that, although low income customers may be more likely than non-low income customers to participate when the discrepancy between the on- and off-peak rate is at its smallest, as the on-peak rate increases, low income customers are more uncertain about how high peak rates may negatively impact their energy bill.

An overall adoption rate of 23% at the lowest off-peak rate (4 cents/KWH) and highest on-peak rate (26 cents/KWH), suggests that the risk of participating in the program and subsequently experiencing increases in energy costs due to failing to modify usage behavior may deter customers from participating despite the potential savings. This effect may play a role in why low income adoption showed minimal increases in adoption as the on-peak rate increased.

The Study Team will work with the potential model team to ensure that these adjusted adoption results fit into the necessary model inputs. These results are our initial results based on customers' willingness to participate, barriers to participation, and awareness.

Table 103. Time-of-Day Rate Program adoption

	n	20 cents/KWH on-peak rate, 10 cents/KWH off- peak rate	22 cents/KWH on-peak rate, 8 cents/KWH off- peak rate	24 cents/KWH on-peak rate, 6 cents/KWH off- peak rate	26 cents/KWH on-peak rate, 4 cents/KWH off- peak rate
Overall	413	16%	18%	21%	23%
<b>Income status</b>					
Non-low income	286	14%	17%	21%	24%
Low income	127	18%	20%	21%	21%
<b>Housing type</b>					
Single family	310	16%	19%	22%	24%
Multifamily	103	15%	16%	17%	18%

Note: Results based on web survey data

Respondents that indicated they would not participate at any TOU rate were asked why they felt that way. Of the 100 respondents that answered, 21% said they simply weren't interested, 19% said it was not conducive to their schedule, and 17% said they did not understand the program. 10% mentioned financial reasons, 10% wanted to remain in control of their energy usage, 8% had other reasons, and 4% were concerned about having to sacrifice comfort.

## 13.4 Conclusion

The key strategies to managing winter-peak demand include efficient technologies and weatherization, DLC programs utilizing smart thermostat controls, and TOU or CPP rate programs. DESC has an opportunity to further address market transformation with these technologies that have low current penetration such as smart thermostats and heat pump water heaters.

Residential customers indicated low awareness of direct load control and TOU rate programs as a concept and indicated that they did not have enough information about the process for participation. Customers were also concerned that their comfort would be sacrificed by participating. Outreach and educational opportunities will overcome some of these barriers, but technology upgrades, especially for smart thermostats in the market will need to be a key strategy to address winter-peaking DR. In addition, improving the envelope of households in tandem with enrolling them in demand response programs is an effective way to bolster energy savings.

In the case of the Alabama Power Residential Time Advantage Demand Rate Plan, they currently have on-peak pricing of 9.5359 cents per KWH during weekdays from 5:00 am – 9:00 am, and off-peak pricing of 7.5359 cents per KWH at all other times (including weekends) during the winter months of November 1st through March 31st. These on- and off- peak rates are closer in price to each other compared to the scenarios the team presented to online survey respondents. However, they have on-peak pricing of 27.5359 c/KWH during weekdays from 1:00 pm – 7:00 pm, and off-peak pricing of 7.5359 c/KWH all other times (including weekends) during the summer months of June 1st through September 30th. This type of pricing is more comparable to the pricing the team presented in our online scenarios. This seasonal difference in time-of-use rates is likely because, like DESC, Alabama Power is a transitional/dual peaking utility. The summer months are still their priority in terms of load reduction, but winter focused programs are becoming increasingly important as their demand load changes in response to changes in climate.

Similar to Alabama Power, DESC should consider a winter time-of-use program with rates that are not appreciably different. As time progresses, the climate and load continue to change, and customers become more comfortable with time-of-use as a concept and modifying their usage behavior, the gap between off- and on-peak pricing can be widened accordingly.

## **Appendix A. Penetration, Saturation, and Equipment Characteristics**

A detailed data table with additional penetration, saturation, and equipment characteristics will be provided as a separate Attachment for Appendix A.

## Appendix B. Summer Peak Demand Response Adoption

Table 104. Summer Smart Thermostat Program adoption

	n	Incentive Level		
		Annual incentive of \$0	Annual incentive of \$25	Annual incentive of \$50
Overall	254	17%	19%	22%
<b>Income Status</b>				
Non-low Income	211	17%	19%	23%
Low Income	43	18%	20%	22%
<b>Housing Type</b>				
Single Family	230	17%	19%	23%
Multifamily	24	17%	18%	20%

Table 105. Summer Time-of-Day Program adoption

	n	20 cents/KWH on-peak rate, 10 cents/KWH off-peak rate	22 cents/KWH on-peak rate, 8 cents/KWH off-peak rate	24 cents/KWH on-peak rate, 6 cents/KWH off-peak rate	26 cents/KWH on-peak rate, 4 cents/KWH off-peak rate
Overall	413	17%	19%	21%	23%
<b>Income Status</b>					
Non-low Income	286	15%	18%	21%	23%
Low Income	127	18%	19%	21%	21%
<b>Housing Type</b>					
Single Family	310	17%	19%	22%	24%
Multifamily	103	15%	16%	17%	17%

## Appendix C. Load Disaggregation Methodology

The Study Team performed a load disaggregation analysis on DESC's customer base to identify customers with electricity usage that was weather sensitive to cold weather, indicating they may have electric heating systems. This analysis constructed individual account-level regression models using monthly electric consumption data. The Study Team ran many regression models for each individual customer before selecting the best model to describe each customer's electricity usage.

The analysis also identified household-specific temperature setpoints for heating and cooling. Temperature setpoint is an estimate of what each customer has their thermostat set to heat or warm their house to: for example, one customer may cool their house to 72 degrees F in the summer and heat it to 65 degrees F in winter. For each set of base temperatures, the Study Team used this load disaggregation approach to estimate separate models for heating only, cooling only, heating and cooling, and base load only (essentially re-specifying the model to drop or include weather terms and running it again for that customer. The separate models are estimated using heating degree days and cooling degree days (HDD and CDD) calculated with different setpoints (65 degrees F, 70 degrees F, etc.) to find the best setpoint for each house.

The benefit of this approach is that it uses different base temperatures to estimate HDD and CDD for each account, and outputs separate slope and intercept terms for heating and cooling loads. The approach also reduces bias in independent variables (HDD, CDD) and slope parameters.

Equation 1. Load Disaggregation General Model Specification

$$\text{KWHt} = \beta_0 + \beta_{0h} + \beta_{0c} + \beta_1 * (\text{HDDtb}) + \beta_2 * (\text{CDDtb})$$

Where:

$\beta_0$  = Base load

$\beta_{0h}$  = intercept shifter for cooling

$\beta_{0c}$  = intercept shifter for heating

$\text{HDDtb} = (\text{Ambient temperature} - \text{Base temperature})$ . This allows the base temperature to vary for computing heating degree days, providing different number of heating degree days for each base temperature, which is reflected in the slope or the relationship between temperature and heating per degree day.

$\text{CDDtb} = (\text{Base temperature} - \text{Ambient temperature})$ . This allows the base temperature to vary for computing cooling degree days, providing different number of cooling degree days for each base temperature, which is reflected in the slope or the relationship between temperature and cooling per degree day.

The parameter estimates on HDD and CDD provide estimates of the account specific use per HDD or CDD. Changes to parameter estimates on heating and cooling degree-day terms, reflect changes in the efficiency (use per CDD or HDD) of the home.

Once each account level model was identified, the Study Team evaluated each model using TMY3 (typical meteorological year, also known as normal temperatures) for HDD and CDD. Using TMY3 weather instead of actual temperatures to estimate CDD and HDD allowed us to create weather neutral estimates of heating, cooling, baseload, and total load.

*Load Disaggregation Methodology*

The Study Team modified source code developed as part of the MIT-licensed open-source platform OpenEEmeter. The code incorporates weather and returns weather-normalized and annualized load disaggregated into the above-mentioned categories for pre-participation and post-participation periods. The code also returns weather-normalized changes in consumption between the pre- and the post-participation periods. The results are available at the individual participant level.

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## Appendix E. Literature Review Sources

This appendix provides the list of secondary sources (Table 106) and utilities (Table 107) included in the literature review.

Table 106. Reviewed Secondary Research Sources

	Author	Title	Sponsor	Year
1	Opinion Dynamics	AIC Income Qualified Initiative Braided Funding Best Practices Research Results	Ameren Illinois	2019
2	Opinion Dynamics	Ameren Illinois Income Qualified Initiative Memo	Ameren Illinois	2022
3	Opinion Dynamics	Ameren Illinois Company 2020 Residential Program Impact Evaluation Report	Ameren Illinois	2021
4	Opinion Dynamics	Ameren Missouri Program Year 2020 Annual EM&V Report Volume 2: Residential Portfolio Report	Ameren Missouri	2021
5	Opinion Dynamics	Ameren Missouri Program Year 2021 Annual EM&V Report	Ameren Missouri	2022
6	Opinion Dynamics	Ameren Missouri 2021 MFMR & MFIE Evaluations	Ameren Missouri	2022
7	Opinion Dynamics	Assessment of Partnerships with Community-Based Organizations	N/A	2021
8	R. Cluett, J. Amann, and S. Ou	Building Better Energy Efficiency Programs for Low-Income Households	ACEEE	2016
9	S. Samarripas, and D. York	Closing the Gap in Energy Efficiency Programs for Affordable Multifamily Housing	ACEEE	2019
10	Opinion Dynamics	Duke Energy Carolinas Low Income Weatherization Program (2016-2018) Evaluation Report	Duke Energy	2021
11	Opinion Dynamics	Energy Trust of Oregon Manufactured Home Replacement Pilot Evaluation	Energy Trust of Oregon	2020
12	Drehobl, and K. Tanabe	Extending the Benefits of Nonresidential Energy Efficiency to Low-Income Communities	ACEEE	2019
13	Opinion Dynamics	Interstate Power and Light Company 2019-2023 Low-Income Weatherization Program Evaluation Report	Interstate Power and Light Company	2021
14	F. Rapley	Leveraging Resources to Serve Limited Income Communities	AESP Spring Conference	2018
15	A. Drehobl, and F. Castro-Alvarez	Low-Income Energy Efficiency Programs: A Baseline Assessment of Programs Serving the 51 Largest Cities	ACEEE	2017
16	A. Gilleo, S. Nowak, and A. Drehobl	Making a Difference: Strategies for Successful Low-Income Energy Efficiency Programs	ACEEE	2017
17	M. G. Bean, and M. McRae	Power to the People: Using Community-Based Approaches to Deliver Efficiency and Sustainability to Hard-to-Reach Populations	ACEEE	2016

	Author	Title	Sponsor	Year
18	M. Shoemaker, A. Gilleo, and J. Ferguson	Reaching Rural Communities with Energy Efficiency Programs	ACEEE	2018
19	Research Into Action	Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy	2015
20	E. Funkhouser, M. McRae, and J. Folks	The Business Case for Retrofitting Manufactured Homes with Mini-Split Heat Pumps: Facing Down the Inefficiency Challenge	NRECA	2016

Table 107. Low Income Programs Offered by Utilities Reviewed

Utility Name	Low-Income Program Offerings			
	Weatherization Program with Utility-WAP Partnership	Utility-only Weatherization Program	Kits or Other Direct Distribution Efforts	Neighborhood Canvassing
AES Indiana		X	X	
Alliant Energy – Iowa	X		X	
Ameren Illinois	X		X	
Ameren Missouri	X			X
Austin Energy		X		
Baltimore Gas & Electric	X			
Commonwealth Edison	X		X	
Detroit Edison Energy		X		
Duke Energy Carolinas	X			X
Entergy New Orleans		X		
Georgia Power	X			
Jacksonville Electric Authority				X
Louisville Gas & Electric		X		
Memphis Light, Gas & Water		X		
National Grid Rhode Island	X			
<b>Total Number of Utilities That Include Offering</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>3</b>

## Appendix F. Data Collection Instruments

### On-site Instrument



DESC Market  
Characterization On-

### Survey Instrument



DESC Market  
Characterization Wet

### In-Depth Interview Guides



DESC Market  
Characterization Con



DESC Market  
Characterization Mid

## Appendix G. Community Specific Partnership Opportunities

Community leaders suggested a number of specific partnership opportunities for Charleston, Aiken, and Saluda. The following organizations were suggested as candidates for partnerships due to their devotion to bettering the communities they serve, as well as the trust they have established with hard-to-reach, low income residents.

### Aiken

- **Area Churches Together Serving (ACTS)**, a non-profit organization whose mission is to provide assistance to residents in need by partnering with other churches, organizations and individuals. ACTS is made up of a network of 65 churches, working to together to assist and provide residents with food security, utility bill assistance, medical and dental services, clothing, houseware and furniture, along with services to help working adults access reliable transportation. ACTS operates with very few paid employees, so the majority of day-to-day operations are handled by dedicated volunteer staff.<sup>63</sup> All leaders the team spoke with from the Aiken community noted this organization as a valuable potential partner, including DESC staff the team spoke with who is a board member for the organization.
- **Christ Central**, a not for profit and completely volunteer-run agency, provides basic needs to the low income and disadvantaged residents, such as food and clothing, along with services to improve self-sufficiency and stabilization for families, like education and job skills training.<sup>64</sup> Faith-based organizations tend to have an especially strong force in South Carolina, highlighting how partnering with Christ Central, a Christianity-led organization with a strong focus on religion, can promote trust with residents and aid program outreach.
- **SBC Community Development Corporation (SBC CDC)**, a non-profit corporation, was founded upon the mission of building senior housing, and providing food and educational services to the community. The organization provides a wide range of human, youth and educational services, and leads many community development initiatives<sup>65</sup>; the community leader the team spoke with noted the organization's accomplishment in building 100 rental properties for those in need of affordable housing. The interviewee the team spoke with voiced a strong interest in establishing a partnership with DESC in order to provide as many services as possible to help benefit the community they serve.

### Saluda

- **The Potter's House**, a non-profit organization, initiates a variety of community events and provides services to families identified as needing assistance by Department of Social Services (DSS), such as Christmas present drives, back-to-school supply giveaways, and family support services including foster parenting classes. A leader the team interviewed described their mission as, "we wake up and whatever the need is that day, that's what the team do," emphasizing the wide scope of services the organization works to provide to local residents, either directly or by partnering with other local agencies.<sup>66</sup> The leader the team spoke with emphasized the organization's strong, trusting relationship with local residents, including the large non-English speaking population. Partnering with an organization such as the Potter's House may present DESC with great potential to educate and

<sup>63</sup> <https://actsofaiken.org/>. Last accessed: March 29, 2022.

<sup>64</sup> <https://christcentralaiken.com/>. Last Accessed: March 29, 2022.

<sup>65</sup> <https://www.sbccdc.com/>. Last Accessed: March 29, 2022.

<sup>66</sup> <https://thepottershousosaluda.com/>. Last Accessed: March 29, 2022.

inform non-English speaking residents who make up a significant proportion of the Saluda's population.

### ACCOMODATING MULTIPLE LANGUGAGES NECESSARY FOR ME&O IN SALUDA

All leaders we spoke with from the Saluda community acknowledged the large Hispanic population living in the region, many with limited to no English-speaking proficiency, requiring the availability of Spanish-translated program materials. One leader also noted the increasing Guatemalan population that is moving into the community, who speak a specific tribal dialect that there is no translator in the community for. This presents an increasingly difficult scenario for conducting outreach to these residents. In the interview, the leader indicated one church in the town with a pastor who is originally from the same village most Guatemalan residents originate from. This pastor has helped with spreading awareness of other resources available to residents within the community and was suggested as a key connection for conducting marketing, education, and outreach to this growing minority population.

*"A lot of times the school will try to solve that problem by sending documents home in English and Spanish, but I'd say 90% of the Guatemala population we work with, don't read and write in English or in Spanish and the primary dialect among that people is Mam. It's not even true Spanish, it's a tribal dialect and we don't have any translators for that language."*  
(Saluda leader)

- **Radius Church**, one of six of the overarching church locations across the state, provides the community with support such as food drives, holiday meals, funding in support of local schools, and allows their building to be used for various community events as needed.<sup>67</sup> One leader the team interviewed suggested partnering with Radius Church in comparison with other churches in the area due to its focus on community outreach, access to greater resources due to being a part of a wide-spread congregation, and their connection to non-English speaking residents. The church provides headsets for non-English speaking attendees to allow them to listen to the service in Spanish, along with weekly Bible studies specifically for the Spanish speaking community. Not only does this organization present an opportunity for better reaching the Spanish-speaking community, but a community leader reported that the pastor is also the local football coach who is very involved and has built a strong rapport with the community.
- **GLEAMNS**, a community-based organization, works to deliver quality services, assistance, and opportunities with emphasis placed on education, employment, and developing self-sufficiency. The CBO offers a variety of services in support of these topics, including head start, after school program, and a workforce development program. GLEAMNS also offers LIHEAP and weatherization services, which supports alignment between their goals and those of DESC.<sup>68</sup>

<sup>67</sup> <http://radiuschurch.org/locations/saluda/>. Last Accessed: March 29, 2022.

<sup>68</sup> <https://www.gleamnshrc.org>. Last Accessed: March 29, 2022.

## Charleston

- **East Cooper Community Outreach (ECCO)**, a non-profit serving income-eligible residents either living or working in one of the 10 zip codes that fall East of the Cooper River, contributes services like dental and medical care, food security, and financial services for utility bills and housing.<sup>69</sup> Leaders from this organization emphasized their use of community outreach, including efforts to reach rural areas where many residents frequently are uninformed of services available to them. Leaders felt that due to the type of service they provide, specifically noting their utility bill and rental assistance programs, they would be a powerful partner for DESC since many of their constituents are those who would benefit most from DESC low income program opportunities.
- **Palmetto Community Action Partnership (PCAP)**, a non-profit organization, prides themselves on their ability to serve the economically underserved residents of Berkeley, Charleston, and Dorchester counties by promoting economic independence through programs and partnerships. Services offered through the organization include classes on financial literacy and budgeting, rental, utility bill, and childcare assistance, affordable housing, youth programs, job training, weatherization services, and many others.<sup>70</sup> One of our interviews consisted of multiple leaders from PCAP, who all agreed that due to the alignment of energy services they provide and the clientele they serve, a partnership with DESC would be influential in increasing the number of low income residents that receive program benefits in the Charleston community.
- **Charleston Promise Neighborhood**, a non-profit organization, with a focus on providing school and youth-related support in the Charleston community through after school programs, health and wellness services for students and in some cases their adult family members, and community and family engagement events.<sup>71</sup> One of the interviewees the team spoke with from this organization indicated the potential for DESC to spread program awareness through the strong force of children's voices by partnering with their organization or other child education-related entities.

*"If you sponsor things at the schools and the kids love it and the kids can say and see Dominion Energy, they talk about it.... our work is in the schools and the team know that typically parents follow things that their students are excited about, especially if [they] have the younger ones in the house."  
(Charleston leader)*

<sup>69</sup> <https://eccocharleston.org>. Last Accessed: March 29, 2022.

<sup>70</sup> <https://palmettocap.org>. Last Accessed: March 29, 2022.

<sup>71</sup> <https://charlestonpromise.org>. Last Accessed: March 29, 2022.

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